THE DESCRIPTION and USE, OF THE UNIVERSAL PLANISPHERES;

OR, TERRESTRIAL and CELESTIAL GLOBES in PLANO.

BEING

Compleat SUBSTITUTES for

A LARGE PAIR of GLOBES.

WITH

Their Applications, in the SOLUTIONS of all the Capital PROBLEMS

IN

GEOGRAPHY, ASTRONOMY, and NAVIGATION.

Invented and Delineated

By SAMUEL DUNN,

Maſter of an ACADEMY for boarding and qualifying young Gentlemen,
in Arts, Sciences and Languages, at CHELSEA.

The Second EDITION, with Additions and Improvements.

LONDON:

Printed and Publiſhed (according to an Act of Parliament)
For the AUTHOR, and W. OWEN, at *Homer's-Head*, near
Temple-Bar, *Fleet-ſtreet*.
MDCCLIX.

COMMISSIONERS OF PATENTS FOR INVENTIONS

BRITISH MUSEUM
1870
MAR

GEORGE R.

GEORGE the Second by the Grace of God, King of Great Britain, France and Ireland, Defender of the Faith, &c. To all to whom these Presents shall come, Greeting. Whereas Our Trusty and Well-beloved [illegible] Mathematician, and William Herbert, Engraver and Printseller of the City of [illegible] have by their Petition humbly represented unto Us, that they have with great Study, Care, Labour, and Expence lately composed, and perfected a Work entitled,

The [illegible] *Pilot*, [illegible] *in* [illegible] *Parts*;

BEING

Complete [illegible] *with their* [illegible] *of all the Capital* [illegible] *and* [illegible]

Which Work particularly [illegible] will be of great Benefit to the Public, and tend to the promoting of the Knowledge of Geography, Astronomy and Navigation. The Petitioners therefore pray Us to grant Our Royal Licence to them for the sole Printing, Engraving, Publishing and Vending the said Work, for the Term of Fourteen Years, according to the Statute in that Case made and provided: We, being willing to give all due Encouragement to Works of this Nature which [illegible]

Of Public Use and Benefit,

Are graciously pleased to condescend to their Request, and do hereby give and grant unto them, as far as may be agreeable to the Statute in that Behalf made and provided, [illegible] Executors, Administrators and Assigns, Our Royal Privilege and Licence, for the sole Printing, Engraving, Publishing and Vending the said Work for the Term of Fourteen Years, to be computed from the Date hereof, Strictly forbidding all Our Subjects within Our Kingdoms and Dominions to reprint, abridge, or translate the same, either in the Like, or any other [illegible] whatsoever, or to import, buy, vend, utter, or distribute any Copies thereof [illegible] during the aforesaid Term of Fourteen Years, without the Consent and Approbation of them the said [illegible] and [illegible] Executors, Administrators, or Assigns, by [illegible] under their Hands and Seals first had and obtained, as they will answer the contrary at their Perils: Whereof the Commissioners and other Officers of Our Customs, the Master, Wardens, and Company of Stationers of Our City of London, and all Our Officers and Ministers whom it may concern, are to take Notice, that due Obedience be rendered to Our Pleasure herein signified.

Given at Our Court at Kensington, the Seventh Day of November, 1757, in the Thirty-first Year of Our Reign.

By His Majesty's Command,

W. PITT.

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G.II R

GEORGE R.

GEORGE the Second by the Grace of God, King of *Great-Britain*, *France* and *Ireland*, Defender of the Faith, &c. To all to whom theſe Preſents ſhall come Greeting: Whereas *Samuel Dunn* Teacher of the Mathematics, and *William Owen*, Citizen and Bookſeller of the City of *London*, have by their Petition humbly repreſented unto Us, that they have with great Study, Care, Labour, and Expence invented, delineated, and perfected a Work entitled,

The Univerſal Planiſpheres, or Terreſtrial and Celeſtial Globes in Plano;

BEING

Compleat Subſtitutes for a large Pair of Globes, with their Uſes in the Solutions of all the Capital Problems in Geography, Aſtronomy and Navigation.

Which Work the Petitioners humbly apprehend will be of great Benefit to the Public, and tend to the promoting of the Knowledge of Geography, Aſtronomy and Navigation. The Petitioners therefore pray Us, to grant Our Royal Licence to them for the ſole Printing, Engraving, Publiſhing and Vending the ſaid Work, for the Term of Fourteen Years, according to the Statute in that Caſe made and provided; We, being willing to give all due Encouragement to Works of this Nature which may be

Of Public Uſe and Benefit,

Are graciouſly pleaſed to condeſcend to their Requeſt, and do therefore by theſe Preſents, as far as may be agreeable to the Statute in that Behalf made and provided, grant unto them the ſaid *Samuel Dunn*, and *William Owen*, their Executors, Adminiſtrators and Aſſigns, Our Royal Privilege and Licence, for the ſole Printing, Engraving, Publiſhing and Vending the ſaid Work for the Term of Fourteen Years, to be computed from the Date hereof, ſtrictly forbidding and prohibiting all Our Subjects within our Kingdoms and Dominions, to reprint, abridge, or tranſlate the ſame; either in the Like, or any other Volume or Volumes whatſoever, or to import, buy, vend, utter, or diſtribute, any Copies thereof, reprinted beyond the Seas, during the aforeſaid Term of Fourteen Years, without the Conſent and Approbation of them, the ſaid *Samuel Dunn* and *William Owen*, their Executors, Adminiſtrators, or Aſſigns, by Writing under their Hands and Seals, firſt had and obtained, as they and every of them, offending herein, will anſwer the Contrary at their Peril: Whereof the Commiſſioners and other Officers of Our Cuſtoms, the Maſter, Wardens and Company of Stationers of Our City of *London*, and all Our Officers and Miniſters whom it may concern, are to take Notice, that due Obedience be rendered to Our Pleaſure herein ſignified.

Given at Our Court at *Kenſington*, the Seventh Day of *November*, 1757, in the Thirty-firſt Year of Our Reign.

By his MAJESTY's Command.

W. PITT.

I Have ſeen and examined Mr. *Dunn*'s Univerſal Planiſpheres, and find them to be four large ſtereographical Maps, with a tranſparent Index placed over each Map, whereby the Circles of the Sphere are inſtantaneouſly projected on the Plane of the Meridian for any Latitude, and the Problems of Geography, Aſtronomy, and Navigation, wrought with the ſame Certainty and Eaſe, as by the Globes themſelves. And as I have read Lectures above 20 Years, and travelled through moſt Parts of *England*, and beyond the Seas; and many of my Pupils may be willing to be certified of the Utility of this Performance; I am deſirous of aſſuring them, that the Principles upon which theſe Planiſpheres and their Operations do depend, are undeniably true, the Uſe of them eaſy and general, and in my Opinion, they muſt be of great Uſe in the Study and Practice of the above Sciences.

London, 26 *Dec.* 1757.

William Griffiſs, Lecturer in
experimental Philoſophy.

J'ay vû & examiné les Planiſphéres de Monſieur *Dunn*, & les ay trouvé être quatre grandes Mappes ſtereographiques, avec un Index tranſparent, & placé au haut de chaque Mappe, par le moyen de quoy, les Cercles de la Sphére ſont projetté trés vite, ſur le Plan du Meridian pour toute Latitude, & les Problemes de Geographie, Aſtronomie, & Navigation, reſous avec la même certitude & facilité que par les Globes mêmes. Et comme je lis depuis paſſé 20 ans, & ay voyagé par preſque toute l'Angleterre, & delà la Mer; pluſieurs de mes Eleves peuvent être aſſurés de l'utilité de cette ouvrage; je veux les aſſurér auſſy, que les Principes ſur les quels ces Planiſphéres ſont fondées & leurs Operations, ſont indubitable, leur Uſage facile & general, & ſelon mon Opinion, d'ungrand Uſage pour la Pratique & l'Etude des Sciences cy-deſſus mentionnées.

Londres, *le* 26 *Dec.* 1757.

Guillaume Griffiſs, Lecteur en
Philoſophie experimentale,

WE whoſe Names are hereunto ſubſcribed, Teachers of the Mathematics in and near *London*, having ſeen and examined the Conſtruction and Uſe of the Univerſal Planiſpheres invented by Mr. *Dunn*; do find them to anſwer in the moſt eaſy and general Manner all the Problems uſually anſwered by the Globes, with equal Certainty and Expedition, and therefore it is our Opinion, that this Work will be of great Uſe to the Public.

J. L. Cowley, Mathematician, *Ludgate-hill.*
J. Welch, Teacher of Navigation, *Hatton-garden.*
Charles Brent, Author of the compendious Aſtronomer.
Thomas Adams, Teacher of Mathematics, *Soho-ſquare.*
Edward Moore, Teacher of Navigation, and Globe-maker, *Deptford.*
Peter Ruſſel, private Teacher of Geography, and the Uſe of the Globes.

NOUS dont les noms ſont ſouſcris, Maitres Mathematiciens dans & aux environs de *Londres*, ayont vû & examiné la Conſtruction & l'Uſage des Planiſphéres Univerſelles, Inventées par Monſieur *Dunn*, les trouvons propres à répondre avec la plus grande facilité, & ſelon la generale maniére, à tous les Problemes aux quels on peut répondre par les Globes, avec autant de certitude que de promptitude, & à cauſe de ce la nôtre Opinion eſt, quélle ſera d'une grand Utilité au Public.

J. L. Cowley, Mathematicien à *Ludgate-hill.*
J. Welch, Precepteur pour les Navigations, *Hatten-garden.*
Charles Brent, Autheur de l'Aſtronomie abrêgée.
Thomas Adams, Precepteur en Mathematiq. *Soho-ſquare.*
Edward Moore, enſeignant les Navigations, & faiſeur de Globes, *Deptford.*
Peter Ruſſel, enſeignant la Geographie, & l'Uſage des Globes.

PRE-

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RECOMMENDATIONS
of the Univerſal Planiſpheres.

MR. DUNN, Teacher of the MATHEMATICS in *London*, having requeſted my Opinion of his UNIVERSAL PLANISPHERES, or terreſtrial and celeſtial GLOBES in *Plano*; I have carefully examined thoſe ingenious and compleat Subſtitutes for a large Pair of Globes; I have duly conſidered their Uſe in the Solutions of the capital Problems in *Geography*, *Aſtronomy*, and *Navigation*; and humbly apprehend, that nothing of that Nature, yet publiſhed, can be ſo conducive to the Aſſiſtance of Teachers, and Advantage of their Pupils, as what Mr. DUNN's Invention appears to me: And I hope, that my good Intentions, in recommending them to ſuch as have not ſeen them, will not be conſtrued into Preſumption; ſince the Merit of the Performance is ſo obvious, that it cannot but gain the Approbation of thoſe, who may be hereafter induced to enquire for them.

Carey-ſtreet, Lincoln's-Inn-Fields,
Dec. 23, 1757.

Stephen Demainbray, L. L. D. Teacher of Philoſophy to his Royal Highneſs the Prince of *Wales*.

MOnſieur DUNN, Maitre de Mathematiques à *Londres*, m'ayant demandé mon Sentiment de ſa *Planiſphére Univerſelle* C. D. de ſes Globes terreſtres & celeſtes *in Plano*. Je les ay trouvé après un examen ſcrpuleux, trés propres à repréſênter les Globes, j'ay fais mes Reflections ſur l'utilité dont ils pourroient être dans la Solution des Problêmes principaux de la Géographie, de l'Aſtronomie, & de la Navigation, & rien de ce qu'on a publié juſqu'icy dans ce Genre, ne ma parût ſi propre tant à faciliter la Connoiſſance de ces Sciences à ceux qui s'y appliquent qu'à ſoulager ceux qui les enſeignent; c'eſt pourquoy je me flatte que ce que je viens d'en dire d'avantageux ne me ſera point imputé comme prévenu en ſa faveur; puiſque je n'ay d'autre deſſein que de recommander, un ouvrage ſi utile à la Societé, & dont on reconnoitra le Merite dès qu'on l'aura vû.

Londres, de Carey-ſtreet, Lincoln's-Inn-Fields, Dec. 23, 1757.

Etienne Demainbray, L. L. D. Precepteur en Philoſophie de ſon Alteſſe Royale Monſeigneur le Prince de *Galles*.

I Have examined Mr. *Dunn*'s Univerſal Planiſpheres, and look upon them to be an uſeful and very ingenious Invention, founded upon unexceptionable Principles; by Means whereof the moſt important Problems in Geography, Aſtronomy, and Navigation, are ſolved with great Accuracy, Eaſe, and Expedition.

London, Dec. 1757.

T. Simpſon, F. R. S. Member of
the Royal Academy of Sciences at *Stockholm*, Mathematical-maſter in the Royal
Academy at *Woolwich*.

J'ay examiné les Planiſphéres Univerſelles de Monſieur *Dunn*, & les ay trouvé être une Invention trés utile & trés ingenieuſe, fondée ſur des Principes infallibles; par le moyen des quelles on peut reſoudre les Problemes les plus importans, ſoit en Geographie, Aſtronomie, ou Navigation, avec une grande exactitude, & une grande Commodité, & Promptement.

Londres, 10bre 1757.

T. Simpſon, F. R. S. Membre
de l'Academie Royal des Sciences de *Stockholm*, Maitre
Mathematicien de l'Academie Royal de *Woolwich*.

I Certify that I have examined Mr. *Dunn*'s new Planiſpheres, and am ſatisfied they are conſtructed on very true Principles; that by them all ſpherical Problems may be readily projected, and ſolved by Inſpection, without the Help of Scale and Compaſſes, Pen and Ink, and that with more Facility and Accuracy than by any Globes of equivalent Dimenſions.

London, Dec. 1757.

J. Bevis, M. D. Member of
the Royal Academy of Sciences at *Berlin*.

JE certifie avoir examiné les Planiſphéres de Monſieur *Dunn*, & en être ſatisfait elles ſont conſtruites ſur de vrays Principes; & par leurs ſecours tous Problemes Sphériques peuvent être projettés & promptement reſous, ſans le ſecours, d'échelle, n'y de Compas, de Plume n'y d'Ancre, & ce la avec plus de facilité & d'Exactitude que par aucun autre Globe d'une Dimenſion equivalente.

Londres, Dec. 1757.

J. Bevis, M. D. Membre de
l'Academie Royale des Sciences a *Berlin*.

PREFACE.

SEEING that from a Variety of terreſtrial and celeſtial Obſervations, it is certain that the Earth and Sea together do make one round Ball, and that the ſame is nearly globular or ſpherical, and that therefore the Sciences of Geography, Navigation and Hydrography, cannot be underſtood without a Knowledge of the Properties of a round Body or Globe. Seeing that this earthly Ball doth either turn round its own Axis from Weſt to Eaſt every 24 Hours, or otherwiſe the celeſtial Bodies do move round it from Eaſt to Weſt in the ſame Time; and that there is the higheſt Probability for the former of theſe Motions, notwithſtanding Phænomena ſeem to contradict the ſame. Seeing alſo, that the fixed Stars, Sun and Planets are ſo far diſtant from us, and their Motions under other Directions, are at all Times ſo exceedingly ſlow in Compariſon with the apparent diurnal Motion, as to bear ſcarce any ſenſible Proportion therewith. Seeing alſo, that theſe Motions are apparently circular, and that Time or Duration itſelf is meaſured by them: From theſe Particulars, it naturally follows, that the Sciences of Aſtronomy, Chronology and Dialling, do principally depend upon the Lines and Properties of a Sphere.

Hence Globes, Spheres, Orreries, and other Machines, peculiarly adapted and deſigned for conveying diſtinct and *adequate Ideas of the Motions of the celeſtial Bodies, and the Figure of the terreſtrial One, have been juſtly eſteemed as the moſt natural Repreſentatives of them. And indeed could theſe Inſtruments be furniſhed at an eaſy Expence, could they be rendered portable, and at the ſame Time exact enough for ſcientific Purpoſes; or were there no Impediments to hinder them from being of general and ordinary Uſe; nothing elſe of this Kind need be enquired after. But as the Acquiſition of theſe Difficulties hath hitherto been thought impoſſible, and is likely to continue ſo; therefore various artificial Delineations and Repreſentations of the Sphere on a Plane, have been introduced by Mathematicians, and made uſe of occaſionally, ſome for conveying Ideas of the Lines and Properties of the Earth and Heavens, others for making of Operations and deducing Concluſions, as the Nature of the Subject hath been able to admit, all of which have been of Utility, and ſome of them more ready and uſeful than Models themſelves.*

Thus Geographers, Aſtronomers and Mathematicians in all Ages, have been able to exhibit their Thoughts concerning Bodies and Spaces of three Dimenſions, by linear Delineations, Diagrams and Schemes on a Plane; different indeed from the Magnitudes themſelves, yet ſo as to afford proper Ideas of all Poſitions and Dimenſions whatſoever; to expreſs large Parts of the Earth's Globe by Maps; to repreſent the Rumb-lines in Mercator*'s Chart by Right-lines; to delineate ſolar Eclipſes geometrically; to exhibit Landſcapes in a Picture by means of optic Glaſſes; and to draw ſcenographically or in perſpective.*

But that Part of this Doctrine applicable to our preſent Purpoſe, and upon which, as a Baſis, our Univerſal Planiſpheres are founded; is the ſtereographic Projection of the Sphere in Plano, or the Delineation and Meaſurement of the Circles of the Sphere on a Plane, as they would appear to an Eye placed in the Superficies of a Sphere, in that Point of the ſolſticial Colure which is at the Equator: The

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Practice of which, ſeems to be almoſt coeval with the Doctrine of the Sphere itſelf; as being plentifully diffuſed throughout innumerable Treatiſes of mathematical Literature; generally practiſed by Men of indiſputable Genius and Capacity; and univerſally received as the beſt intermediate Means, without the Globe itſelf, for attaining diſtinct Ideas of ſpherical Lines. Nor is it to be unobſerved, that the Antients have been very peculiar in chooſing the ſtereographic Method for deſcribing theſe Lines; when at the ſame Time, if a mere arbitrary Delineation only would have anſwered the ſame End, innumerable other Ways much eaſier and readier for Practice might have been propoſed. And herein we may diſtinguiſh the Judgment of the antient Geometricians, although Antiquity be ſilent on this Head. For ſuppoſing the Eye to be placed at a Point in the Surface of the Sphere, and projecting the Circles of the Sphere on a Plane, theſe Circles will alſo be Circles in the Projection, a pyramidical Solid is hereby formed, the geometrical Propoſitions, relating to ſimilar Triangles, are immediately applicable, a great Variety of curious and uſeful Theorems are readily inveſtigated, and the whole Syſtem of ſpherical Geometry, becomes demonſtrable by Euclidean Principles. Whereas in a mere arbitrary Deſcription of the Sphere on a Plane, without Regard to any ſuch Principle, not one of theſe Advantages can be expected, nor can any others be introduced in their Stead, no geometrical Compariſon can be made, and every Enquiry and Determination will be vague and erroneous.

Hence our Univerſal Planiſpheres are ample Inſtruments for geographical, aſtronomical, and nautical Purpoſes, have but few hidden Sources of Error, but what is common to all Maps, and the Gores of Globes themſelves, the Contraction and Expanſion of Paper by drying and wetting, which although ſomewhat conſiderable upon a large Sheet, whereas the Gores of Globes, as ſuppoſed to be printed ſingly on ſmaller Pieces of Paper, may be thought to receive leſs

Errors hereby, yet we ſhall do the beſt in our Power to remove this Inconvenience; by carefully mounting ſuch as paſs through our own Hands.

Whereas, if it be conſidered what unexact Inſtruments common Globes are, and how many more Sources of Inaccuracy they admit of; that if the Horizon ſhould differ ever ſo little from a perfect Plane, if the Centre of the Globe ſhould be ever ſo little out of the Plane of the Horizon, if the Axis ſhould not paſs through two Points diametrically oppoſite to each other in the braſs Meridian, or the two Extremities of the Axis ſhould not be perpendicular to the Surface of the Globe; if there ſhould be an Imperfection in the Figure of the Surface, or Errors in making or paſting on the Gores; if the Globe once happens to ſlide on its Axis, as it frequently doth by changing the Poles, the Quadrant of Altitude be not duly extended, or the Parallax of the Eye be not carefully avoided; in either of theſe Caſes, and in many others of the like Nature, the Exactneſs is loſt, the Determinations by them are quite uncertain, and it is eaſy to ſee that theſe Planiſpheres having none of theſe Imperfections, with Reſpect to the Accuracy in ſolving Problems, may exceed the largeſt Globes uſually made. Notwithſtanding which Globes themſelves are very uſeful, and may be ſaid to be almoſt abſolutely neceſſary for giving the Generality of Perſons an Idea of the Lines and Properties of the Sphere, they are curious Ornaments for the Cabinets of the Curious, and ſhew the Motions of the Earth round its Axis, or the apparent Motion of the Heavens in a moſt adequate and exact Manner, but are ſubject to many Caſualties and Accidents on Account of their ſpherical Form. Hence Mr. Moore's *new Globe,* 31 *Inches Diameter, the Work of more than* 7 *Years ingenious Application, now publiſhing by Subſcription, delineated in a moſt exact and elegant Manner, according to the lateſt geographical Diſcoveries, had like to have been accidentally broken to Pieces, and required much Time and Care for the Reparation: And our own* 28 *Inch celeſtial Globe,*

Globe, in removing from London *to* Chelſea, *received a Fracture of more than a Foot in Diameter. Nor can all the Accidents which are daily happening to theſe Machines be ennumerated, as is well known to Globe-makers, who ſometimes take the Charge of ſending their Goods to a great Diſtance, and receive great Damages thereby.*

In the firſt Edition of this Work, being convinced that the Method propoſed of ſolving Problems by the Planiſpheres, was founded on mathematical Principles, we did not think ourſelves obliged to enter into any Proof on that Head, but being told by ſome Friends, whoſe Opinion and Learning we reſpect, that we had not done ourſelves and our Invention juſtice, and that it might be proper to confirm the Truth of the Method, by ſuch an Authority, which would be particularly uſeful to thoſe who were leſs verſed in Science, we yielded to their Reaſons; and ſhall here preſent the Reader with a brief Illuſtration of the ſaid Principles, and without entering mathematically into the Nature of Projection, ſhall explain it in a Manner which ſeems moſt eaſy and familiar to Conception.

And here it is to be obſerved, that ſince the general Phænomena of the heavenly Bodies depend not upon their abſolute Diſtances, but on their relative Poſitions to one another, and to certain imaginary Circles, called great Circles of the Sphere; therefore, for the greater Eaſe of Conception, and a readier Explanation of the Phænomena, Aſtronomers refer the Sun, Moon, Planets and Stars to the Surface of one common Sphere, which they call the celeſtial Sphere, having the Eye of the Obſerver for its Centre, or rather as being concentrical to the Globe of the Earth, the Magnitude of which is inconſiderable with reſpect to that of the imaginary celeſtial Sphere.

In this Surface, the celeſtial Bodies are ſuppoſed to be placed, like ſo many golden Nails, in a Roof, and herein alſo their reſpective Motions, whether real or apparent, are conceived to be performed.

From hence, is immediately derived the practical Uſe of the artificial celeſtial Globe, it being a direct Repreſentation of the imaginary celeſtial Sphere; as the practical Uſe of the artificial terreſtrial Globe is derived from its being a direct Repreſentation of the true terreſtrial Sphere.

It may ſeem therefore, at firſt Sight, as if nothing but artificial Globes could ſolve the Problems of the Sphere, ſince nothing but a Globe can repreſent the Poſition and Diſtance of Points on a Globe, in their true and proper Relation to each other. Nevertheleſs, if the Spheres be projected, as they are in theſe Planiſpheres, according to a regular and mathematical Projection, it is certain, that the Diſtances and Poſitions of Places and Stars (though different from what they really obtain on the real Spheres) will bear ſuch a certain and determined Relation to each other, as, with the Help of proper Rules, to enable any one to ſolve all the Problems of the Sphere, the ſame as he would do on the artificial Globes. And this is done principally in theſe Planiſpheres, (and herein the Peculiarity of our Invention conſiſts) by Means of a Projection of the great Circles, and Parallels of the Sphere, called the Projector; *and by the Motion of the ſame, according to the Nature of the Problem, the Anſwer is brought out. For the* Projector *which lies above the Planiſphere, being printed on a very fine Paper, and being oiled, the black Circles, Lines and Points in the* Planiſphere *underneath, are clearly viſible through the* Projector, *without any trouble or ſtraining of the Eye. Of theſe black Circles and Lines on the* Projector, *ſome will repreſent the Horizon, Meridian, vertical Circles,* &c. *according to the Nature of the Problem to be ſolved.*

The Planiſpheres, in moſt of the Problems, are rectified for uſe, in a ſimilar Manner to the Rectification of the Globe, and the Place of the Sun, Moon or any Planet, or Comet may be pointed out, by a Mark or Patch, as is uſual in ſolving Problems upon the Globes. The following Compariſon, which occurs to us, may ſerve to ſhew the

Conformity between theſe Planiſpheres and common Globes, and that the firſt may ſolve the Problems as well as the latter. But we deſire it may be taken merely as an Illuſtration, and not as an Inference to derive Honour to our Invention from ſo advantageous a Compariſon which it by no Means deſerves, and which the Inference is not deſigned to convey. Common Globes, lead the Artiſt directly to the Point in View; thus, in great Circle-ſailing, the Artiſt contemplates his Courſe in a great Circle upon the artificial Globe, as if it was on the real One; and theſe Planiſpheres lead him to the ſame End, though more indirectly, yet as readily and eaſily; the Places indeed in the Planiſpheres are put out of their natural Order and Poſition, (and ſo they are in Mercator's *Chart) yet, as long as this is done according to a certain and regular Principle, adapted to the reſpective Nature of each Conſtruction, the Artiſt attains the ſame End, and perhaps with greater Exactneſs. Hence it is preſumed, in Favour of theſe Planiſpheres, that, though the Nature of the Subject doth not admit of their conveying ſuch clear Ideas as the Globes do, yet, in Point of* Practice *and* Exactneſs, *they exceed even Globes of a much larger Diameter. The whole external Surface of a Sphere, being equal to the Area of four great Circles of the Sphere, and each Sphere in theſe Planiſpheres being projected only into two great Circles, it follows, that a Globe having the ſame Diameter with theſe Planiſpheres, which is ſomewhat more than* 21 *Inches, will contain double the Quantity of Surface to what the two Planiſpheres, repreſenting the ſame Globe, do contain; thus the Surface of the Globe will contain* 350 *ſuperficial Inches, and the Planiſphere of the ſame Diameter* 175 *ſuperficial Inches. But, the Sides of ſimilar Planes, being as the Square-roots of their Areas; and the Square-root of* 350 (18.70) *being to the Square-root of* 175 (13.23) *as* 21.2 *to* 15. *it follows, that theſe Planiſpheres ought,* (cæteris paribus) *on this Suppoſition, at a Mean, only to equal, in the Exactneſs of ſolving*

ing Problems, Globes of 15 Inches Diameter. Again, ſeeing that the Degrees near the Centre of the Planiſphere (where, all great Circles being inſenſibly different from Right-lines, the Diſtances and Poſitions of Places may be as readily meaſured as on a Plane, without ſenſible Error) are but half the Length of thoſe in the Circumference, and thoſe Degrees in, and near the Circumference, are equally large with thoſe on a Globe of the ſame Diameter with the Planiſpheres; it follows, that, at a Mean, theſe Planiſpheres will be equally exact with Globes of 16 Inches Diameter, and but little inferior to common Globes of 17 Inches Diameter.

Furthermore, it is very well known, that in the ſtereographic Projection, which is that here made Uſe of, the Eye is ſuppoſed to be placed in the Surface of the Sphere, looking at the Concavity of the oppoſite Hemiſphere, and thereby, projects the ſaid Hemiſphere upon the Plane of a great Circle, perpendicular to a Line drawn from the Eye to the Centre of the Sphere, and that this is done by the Interſection of Lines drawn from the Eye to each Point of the Hemiſphere, and cutting the ſaid great Circle's Plane. It is Evident, therefore, that every great Circle, paſſing through the Centre of the Projection, will be a Right-line, and therefore, if any Place be found in the Circumference of the Planiſphere, that Diameter of the Planiſphere which interſects the Periphery, at the Diſtance of 90 Degrees from the ſaid Point, on each Side, meaſured along the Circumference of the Planiſphere, or that Diameter, which is perpendicular to a Line joining the ſaid Point and the Centre, will be the rational Horizon of that Place in the Circumference, and every Point in this Line, repreſenting the Horizon, will be 90 Degrees diſtant from the Point in the Circumference repreſenting the Place. Hence from the Nature of the ſtereographic Projection, the greater and leſſer Circles of the Sphere, are here ſhewn by circular Arcs, which, in any other Projection, would be Curves of a much more difficult Deſcription; and a greater Equality of Proportion is alſo kept up thro' the

the whole, *than in the Orthographic, Gnomonic, or any other Projection hitherto practiſed. Therefore, ſeeing that a Place given in the terreſtrial Planiſphere, may be referred to the Circumference, along the ſame Parallel of Latitude, and a Place given in the celeſtial Planiſphere, may be referred to the Circumference, along the ſame Parallel of Declination, the Place being referred to the Circumference, the Circumference will become the Meridian of the Place; the Sun, Moon, and every other heavenly Body, keeping in the ſame Parallel nearly for 24 Hours, will perform their apparent diurnal Revolutions perpendicularly over that Parallel of Latitude, which is equally diſtant from the terreſtrial Equator; as the Luminary or Star, at that Time, is diſtant from the celeſtial Equator, that Place on the Planiſphere, to which the Star is Perpendicular, will be found, in ſome Part of that Parallel of Latitude, which anſwers to the Declination of the Star. When the Luminary comes over that Part of the Parallel of Latitude, which cuts the Circumference, then the Star is upon the Meridian, and to Places in greater Degrees of North Latitude is ſaid to be South; as the Star moves uniformly along the Parallel of Latitude, and comes to the Horizon, it ſets; the reſt of its Courſe will be along the Parallel, below the Horizon, if it be a Star that ever ſets: The Number of Degrees contained between that Part which cuts the Circumference when the Star ſouths, and that which cuts the Horizon, will be the ſemidiurnal Arc or the horary Angle between the ſouthing and riſing or ſetting, and is turned into Time at the Rate of* 15 *Degrees to an Hour for the Sun,* 360 *Degrees to* 23 *Hours* 56 *Minutes for the Star, and* 360 *Degrees to the Interval of Time between the Moon's ſouthing from one Day to another. The ſeminocturnal Arc may be found in like Manner, by converting the Remainder of the Parallel below the Horizon, into Time, or elſe by ſubtracting the ſemidiurnal Arc, from half the Time of diurnal Revolution of the Star. When the firſt Point of Aries* *is perpendicular to the Centre of Projection, (which always happens in 24 Hours) the Ecliptic will be projected into a Right-line as it is marked on the terreſtrial Planiſpheres; whence, the Sun's Declination, and Right-aſcenſion, are found, having his Longitude given, and alſo any one of the three given, the other two are found. The next Thing which may ſeem to require Explanation, is the Projection of the Meridians and Parallels, which are dotted off to Degrees on the* Projector, *alſo, the Manner and Reaſon of its ſolving the Problems.*

As the Planiſpheres are ſtereographical Projections of the Places or Stars on the terreſtrial and celeſtial Spheres; ſo the Projector *is a ſtereographic Projection of the Meridians and Parallels of the Sphere to the ſame Radius; therefore, when the Points N. and S, or the North and South-poles on the Planiſphere, are fitted to the two Poles of the* Projector, *the Meridians of the* Projector *repreſent Circles of Latitude or Circles of Declination, and the Parallels repreſent Parallels of Latitude or Parallels of Declination, according as the terreſtrial and celeſtial Planiſphere is uſed. But, as it is by the Motion of the* Projector, *round the Centre, over the Planiſphere, that moſt of the Problems are performed (which Motion anſwers generally to the ſetting of the Globe to the Latitude of the Place) it may be proper to ſhew how this is done.*

It has been ſaid before, that the Meridians and Parallels of the Projector, *when the Points Z and N are brought to the Poles of the Planiſphere, do repreſent the Meridians and Parallels of the Sphere; and then all Places or Stars, laying under the ſame Meridian of the* Projector, *are found upon one and the ſame great Circle upon the Globe. But if the Points Z and N are put upon other Points of the Circumference, then, for the ſame Reaſon, the Meridians of the* Projector, *will ſtill repreſent great Circles of the Sphere, and all Places, found under the ſame Meridian of the* Projector, *do lie in the ſame great Circle upon the Globe,* *which we may eaſily apprehend, if we conſider, that, all great Circles, which paſs at an equal Diſtance, all round, from that Point which is the Centre of the Projection, will be alike projected, all round upon the Plane of the Projection at equal Diſtances from the Centre of the Projection. Hence, an eaſy Solution is given, of that Problem, which ſeems moſt likely to embaraſs us, in a Planiſphere, which is, to find the Diſtance of two given Places, or two given Stars from one another, in the Arch of a great Circle, for it is but turning the* Projector *about, 'till one of the Meridians of the* Projector, *or at leaſt one row of its Dots, either falls over the two given Points, or at leaſt is parallel to them, and the Diſtance in Degrees, upon the* Projector, *between the two Points, will be the Diſtance required. To give another ſimilar Inſtance, let it be required to find either the Zenith-diſtance, or the Altitude of any celeſtial Phænomenon from the Declination and Time of ſouthing of the Phænomenon given. Find the Point upon the Parallel of Latitude, anſwering to its Declination at the given Time, and move the Slider round, 'till the Pole of the Planiſphere is turned from the Horizon of the* Projector, *ſo many Degrees as is the Latitude of the Place of Obſervation; then the Horizon of the* Projector *is the rational Horizon, and the Number of Degrees contained upon a Meridian of the* Projector, *between the Place of the Star on the Parallel of Latitude and the Pole of the* Projector, *is the Zenith-diſtance of the Star, as the Number of Degrees between the Place of the Star on the Parallel, and the Horizon, meaſured upon the ſame Meridian, paſſing through the Place of the Star, is the Star's Altitude.*

It may, perhaps, conduce to the better Underſtanding of the Nature and Grounds of the working of the Problems, to ſhew the direct Analogy between the Manner of performing them by the Planiſpheres, and the Globe. And, this may be done by ſuppoſing a Semi-globe or Sphere, which ſhall here anſwer to the Projector, *with all its Circles and Lines* *drawn thereon, to be placed upon an horizontal Plane, and at the ſame Time the Eye of an Obſerver, or luminous Point, to be placed at the Diſtance of a Semi-diameter, above the Centre, in the Perpendicular to that Plane; then, it is certain, that all the Lines, which naturally ſubſiſt on the Surface of the Semi-globe or Sphere, will be artificially repreſented on the Plane, and whatever is formed in the One will alſo, in a perſpective Manner, be formed in the other. Now, if we ſuppoſe another Semi-globe, having the Delineations, whether of Lands and Seas, or Stars, and which ſhall here anſwer to the Planiſphere placed under the* Projector, *and the Eye of the Obſerver, or luminous Point, alſo the Superficies of the inward Semi-globe to be at reſt, whilſt the Cap turns horizontally round its Centre, when the Cap is thus in Motion, the ſame Parts of the Cap or moveable Superficies, will always coincide with the ſame Parts of the immoveable Superficies, alike on the Globe as on the Projection reſpectively, and hence, the Rotation of the Cap will be repreſented by that of the Plane. Therefore, ſeeing that the Problems of the Globes, do require no more than ſuch a Revolution, the Uſe of the Globes may be eaſily anſwered by a Plane. Hence, as in moſt of the Problems of the Globe, the Place is brought to the Zenith and to the Horizon, by elevating the Pole to the Latitude of the Place, and by bringing it to the Meridian, ſo in like Manner, in the Planiſpheres, the Pole in the Circumference or Meridian of the* Projector, *is brought to the Zenith on the Planiſphere, by which Means, the Horizon of the* Projector, *becomes the rational Horizon, and anſwers to the wooden Horizon of the Globe, and the Pole becomes elevated above the Horizon of the* Projector, *anſwerably to the Latitude of the Place. So that the Planiſphere, in theſe Circumſtances is an exact projected Repreſentation of the Globe, in its uſual Poſition, when it is ſet to the Latitude of the Place, and the Place brought to the Meridian. For if* *the Eye was placed in the weſtern cardinal Point of the wooden Horizon of the Globe, and ſo as to touch the ſame, then the Eye, being in the Plane both of the Equator and Horizon, they would both be projected into Right-lines, as they are found upon the Planiſphere; the Places alſo being in the Zenith and in all Parts of the Meridian, would be ſeen in the Circumference of the Projection, and therefore they are placed in the Circumference of the Planiſphere, ſo that we may refer them thither by the Parallels of Latitude, which anſwers to bringing the Place to the Meridian on the Globe, by the Motion of the Globe round its Axis. And thus would the Eaſtern Planiſphere, with all its vertical Circles and Almicanthars, be viewed in Perſpective, and would appear like the Planiſphere with the* Projector.

Indeed, the Planiſpheres are not projected to anſwer the outward, but inward perſpective View of the Globe; for as the Concavity of the oppoſite Hemiſphere is ſeen by the Eye in Perſpective, every Thing on the Planiſphere takes a contrary Situation to what it would obtain, was the Eye to view the external *Superficies of the Globe; therefore, tho' the Perſpective is reverſed in Planiſpheres, with the relative Poſitions of Places to one another, yet the Places are always ſet right again in their proper Situations, as if the Obſerver was to view the external Surface of the Globe. Otherwiſe the Eaſtern Planiſphere is projected, to anſwer the perſpective View which the Eye would have of the Eaſtern Hemiſphere, if the Eye was placed in the eaſtern cardinal Point, touching the Globe, and the Eaſtern Hemiſphere was depreſſed, ſo as to depart from the Eye, and penetrate the Solidity of the Globe, and its Convexity ſhould yield inward, and be turned into a like Concavity, and be applied or fitted to the Concavity of the oppoſite Weſtern Hemiſphere, the perſpective View, which the Eye ſtill retaining its Place, would have, of the Surface of the Eaſtern Hemiſphere, thus transferred, would anſwer exactly to the*

Projection of the Eaſtern Planiſphere, when ſet to the Latitude of the Place by Means of the Projector.

Having in the foregoing Explanation, endeavoured to give the Reader a general Idea of the Nature of the Planiſpheres, and of the Manner in which the Problems may be ſolved by them, as well as of the Principles on which the Juſtneſs of the Solution is founded, we ſhall now introduce him to another and very different Method of ſolving Problems by the Planiſpheres, from what was delivered in the firſt Edition of the Precepts, or than has been yet hinted at in the foregoing Pages; which will alſo be exemplified in the following Precepts; a Method which we flatter ourſelves will be looked upon as very extenſive in Uſe, ready in Practice, and as conveying Ideas not much inferior to what the Globes convey, either in Clearneſs or Preciſſion: (For in Point of Exactneſs of the Solution of Problems, it has been allowed by the judicious and impartial that the Planiſpheres exceed even Globes of a much larger Diameter.)

Hitherto, we have taken the Liberty to ſuppoſe the Place of the Obſerver in each Operation to be transferred to the Meridian, or the Circumference of the Planiſpheres, and by this Method, all the Circumſtances, depending on the diurnal Motion, are readily and conveniently ſolved, when the Declination and Time of ſouthing of the Planet or Star are given. But, as the Artiſt may think it a more natural and univerſal Method to ſolve the Problems without removing the Places on the terreſtrial, or the Stars on the celeſtial Planiſpheres, from their Situation as there laid down; and, as in many Caſes, it may be uſeful and agreeable, to ſee at one View, the relative Poſition of the Stars, to different Places of the Earth at the ſame Time, or the relative Poſitions of various Stars at the ſame Time both to one another, and to the Horizon and Verticals of the Place in the ſame Manner as is done by the Globes, it ſeemed that it would be no inconſiderable Addition to, and Improvement of our Invention,

vention, if we could inveſtigate ſuch a Method and preſent it to our Readers.

Upon a little Conſideration, and an Attention to the Nature of ſome of the principal Problems, which might be propoſed to be ſolved, this ſeemed more eaſy to us than we could have expected, and ſo obvious when found out, that we were almoſt ſurprized that we had not fell upon it before. This Method, we ſhall briefly point out, in the Caſe where the celeſtial Planiſpheres are uſed, where indeed it is of the greateſt Uſe, though it alſo obtains in the Uſe tf the terreſtrial Planiſpheres. This depends then chiefly, upon finding what we call the Place of the Zenith *upon the celeſtial Planiſphere, or that Part of the celeſtial Planiſphere, the correſponding Point to which in the Heavens is, at that Time, in the Zenith of the given Place. The given Place of the Obſerver, is ſuppoſed to be projected upon the celeſtial Planiſphere, or to be referred to that Parallel of Declination, which anſwers to the Parallel of Latitude of the given Place. The given Place, or, if you pleaſe, the Zenith, or Place of the Zenith, is conceived to move uniformly along its Parallel of Declination, every Day, from Weſt to Eaſt, in like Manner as any Point upon the Earth's Surface, by its diurnal Rotation, really deſcribes a parallel Circle to the Equator, or as the artificial Globe repreſents the ſame.*

To find the Place of the Zenith at Noon, find the Sun's Place in the Ecliptic, on the Planiſphere, and that Point of the Parallel of Declination, which lies under the ſame Meridian with the Sun, is the Place of the Zenith at Noon. *If the given Time be before Noon, remove the Place of the Zenith along the ſame Parallel ſo many Degrees, to the Eaſt of its Place at Noon, as anſwer to the apparent diurnal Motion of the Heavens in the given Number of Hours, which is at the Rate of* 15 *Degrees to each Hour. If the given Time be after Noon, remove the Place in like Manner to the Weſtward of its Place at Noon. The Place of the Zenith at the given Time, being thus found, a compleat*

Repreſentation of the apparent Situation of the Heavens, is exhibited: For the Place of the Zenith being found, relative to the celeſtial Sphere, and conſequently the Meridian of the ſame, or the Meridian paſſing through the Place of its Zenith; it is evident, that the Sun and all the Stars, are found in their true relative Poſition, with reſpect to the Zenith, no leſs than they are with reſpect to each other. Any Meridian of the Projector *paſſing through the Place of the Zenith, is a vertical Circle, and the Meridian of the* Projector, *which is every Way* 90 *Degrees diſtant from the* Zenith, *is the* Horizon. *To find the vertical Circles, turn the Planiſphere round the Centre, and all the Meridians of the* Projector, *which ſucceſſively paſs over the Zenith, are the vertical Circles. Whence, it is evident, that if the Zenith and any Star, be both brought under the ſame Meridian of the* Projector, *that Meridian will be the Vertical paſſing through the Star, and the Number of Degrees intercepted thereon, between the Zenith and the Star is the Star's Zenith Diſtance, the Compliment of which, to* 90, *is the Star's Altitude. The Horizon is found by turning round the* Projector, *'till the Zenith comes under that Diameter of the* Projector *which is called its Horizon (though in this Caſe it doth not anſwer to that Name) then count* 90 *along the Horizon of the* Projector, *and the Meridian paſſing through the* 90*th Degree, will be the Horizon; for this Meridian will be at the Poles* 90 *Degrees diſtant from the Zenith, becauſe the Zenith is now in the Horizon of the* Projector, *and every Point of this Horizon is* 90 *Degrees from the Poles: And a great Circle which is* 90 *Degrees diſtant from any Point in three Places, will be a great Circle, having that Point for its Pole. Here, all Stars upon this Horizon, will be either riſing or ſetting; if it be the eaſtern Part of the Horizon, they will be riſing; if it be the weſtern Horizon, they will be ſetting; all Stars lying between the Horizon, or nearer the Zenith than the Horizon, will be above the Horizon;*

and all Stars lying without the Horizon, will be below the Horizon.

Thus the Horizon and vertical Circles may be found and ſhewn by Inſpection, and the Problems depending upon them, clearly and readily ſolved, for the Performance of which, we have given ample Inſtructions in the following Precepts.

Furthermore, for making this ſecond Edition more compleat, we have given a Deſcription of the ſolar Syſtem, *as it is well known to be conſtituted, from the Diſcoveries which have been made by the beſt Philoſophers and Aſtronomers; which we hope will not be unacceptable, it being introduced in a ſhort and ſummary Way, for the Information of ſuch as have neither Opportunities nor Diſpoſitions for making deeper Enquiries into the natural Cauſes of thoſe Phænomena. To have omitted an Article of this Nature in this Treatiſe, we think would have been improper, for notwithſtanding ſcarce any thing but the apparent diurnal Motion can be repreſented by the Globes, the Obliquity and other Properties of the Planet's Orbits being of a more aſtronomical and phyſical Nature, and not to be repreſented by circular Machines, yet as moſt good Treatiſes of the Globes, do contain ſomething of this Kind, we have complied with Cuſtom in this Part of our Work.*

For theſe Reaſons we have alſo given a ſhort Account of the Principles *of* Geography, *together with ſeveral Tables for underſtanding the moſt uſeful Particulars relating to the principal Parts of the known World. Alſo other Tables of a more ſcientific Nature, for the Purpoſes of Calculation and Inſpection, Uſe and Amuſement. The vacant Space left after each Problem, is to be filled up by the Practitioner, with ſuch Examples as himſelf or his Preceptor ſhall chooſe to ſet, in the doing of which, we recommend a careful and regular Arrangment of the Data and Quæſita, by the Help of ſlight penciled Lines, as the Book when ſo filled out, will not only contain a great Variety of Problems, with their Solutions* *by the Pupil himſelf, but will then be a more valuable Repoſitory than at firſt. The blank Column in the Table of the Sun's Place, may be filled out with ſuch remarkable Days of the Year as each reſpective Reader ſhall chooſe to inſert. Should the ſmall Piece of Linnen, Silk, or Vellum, at the Centre of the Slider get looſe, it may be faſtened by melted Glue.*

Several other Uſes may be made of theſe Planiſpheres, beſide what we have introduced in the following Treatiſe, and which we preſume our more ingenious Readers will readily diſcover; ſuch as the ſtereographic Projection on the Plane of the Meridian for any Radius leſs than that of the Planiſpheres, by the Help of a Pair of proportional Compaſſes, whereby a great Variety of Caſes in ſpherical Geometry will be reduced to almoſt a ſingle Proceſs; even the orthographical Projection itſelf may be made hereby, and all the Parts of an Ellipſis truly delineated and meaſured, the Paths of the Planets may be deſcribed among the fixed Stars, and the Appearances of Eclipſes at different Places on the Earth's Globe may be known, the Diſcuſſion of all which would be unneceſſary; wherefore I ſhall here conclude this Preface, and uſe my beſt Endeavours for the Satisfaction of ſuch Perſons as chooſe to apply to me for theſe Things.

The Academy at Chelſea,
Dec. 1, 1758.

S. DUNN.

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212. 101. Given the Variation of the Compaſs, at two Places, whoſe Difference of Latitude and Difference of Longitude are given, to find the Latitude and Longitude of each of thoſe Places.
Margin. A new and uſeful Hint concerning the *Angle of the Sun's Poſition*, to the Pole and Zenith.

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ERRORS *of the Preſs, which the Reader is requeſted to correct with the Pen. Note, p. ſignifies* Page, *l.* Line, *f.* for, *r.* read.

PAGE 1. *l.* 26. *f.* or forward, *r.* or *Motion* forward; *p.* 5. *l.* 3 and 4. *f.* Apſides, *r.* Apſis; *l.* 38. *f.* always inverſely, *r.* always *nearly* inverſely; *l.* 40. *f.* always as, *r.* always *inverſely* as; *p.* 6. *l.* 18 and 19. *f.* the Planet, *r.* the Diſtance of the projected Place of the Planet on the Ecliptic from the Earth; *p.* 7. *l.* 22. *f.* little more denſe, *r.* little *leſs* denſe; *l.* 29. *f.* of that, *r.* of the Earth and that; *p.* 27. *l.* 25. *f.* 40,000, *r.* 400,000; *p.* 29. *l.* 14 and 27. *f.* Axis, *r.* Axes; *p.* 32. *l.* 26. *f. June* 10, *r. June* 12; *l.* 27. *f. June* 8, *r. June* 10; *l.* 28. *f. Dec.* 13, *r. Dec.* 16; *l.* 29. *f. Dec.* 11, *r. Dec.* 14; *p.* 55. *l.* 1. *f.* 73, *r.* 73 and 74; *p.* 58. *l.* 37. *f. Saxony*, *r. Saxons*; *p.* 59. *l.* 11. after *Weſtminſter*, *r.* when 9th is a *Sunday*; (*l.* 13. after 10th in ſome Copies, *r.* when 9th is a *Sunday*;) *p.* 87. *l.* 15. *f. Scytian*, *r. Scythian*; *l.* 8. *f.* valient, *r.* valiant; *p.* 89. *l.* 6. under Religion for Ditto and *Engliſh*, *r.* Ditto; *l.* 6. under Manners for Ditto and *Engliſh*, *r.* Ditto; *p.* 142. *l.* 16. *p.* 143. *l.* 20. and *p.* 144. *l.* 6. *f. Gnomen*, *r. Gnomon*.

AS the Limits to which we have been neceſſarily confined for rendering the Contents of this Treatiſe within the Compaſs of an ordinary Pocket Volume, would not admit of being ſo ample on ſeveral important Problems, as we could have been, of which, Problem 48, may be reckoned among thoſe of greater Utility, we hope it will not be unacceptable to our Readers, if we particularize the ſame by Way of Specimen here.

PROBLEM.

To find the Longitude of a Place, on Land, or at Sea, by the celeſtial Bodies?

OBSERVATION.

Of all the Methods, that have been hitherto propoſed, for finding the Longitude, either on Land or at Sea, by the celeſtial Bodies, that by the Eclipſes of *Jupiter*'s Satellites, hath been generally found to be the beſt for Land, and that by the Appulſes of the Moon to the fixed Stars, beſt for Sea.

Now if it be known by Calculation, that an Eclipſe of one of *Jupiter*'s Satellites, or an Appulſe of the Moon to a fixed Star, will happen at a certain Hour and Minute under a known Meridian, and the ſame Eclipſe or Appulſe, is obſerved under another Meridian, the Difference between the computed and obſerved Time, being converted into Degrees and Minutes, is the Difference of Longitude between the two Meridians. But farther, ſuppoſing a Table to be exactly calculated, ſhewing the Times when ſuch Eclipſes or Appulſes will happen under a known Meridian, it will ſtill be neceſſary to know nearly the Times when ſuch Eclipſes or Appulſes are to be expected, at a Place whoſe Longitude is either known pretty nearly, or not at all. Now that a Pair of Globes, and therefore our Planiſpheres, are exceedingly uſeful for theſe Purpoſes, will appear from the following Conſiderations. 1. Becauſe the Right-aſcenſion and Declination of the Planet (whether it be *Jupiter* or the *Moon*) is known in Degrees and Minutes, and conſequently the Place among the fixed Stars, at the Time of the Eclipſe or Appulſe. And becauſe the Obſerver may take the Latitude he is in, and thereby find the Time of the Planet's Continuance above the Horizon; therefore, if the Longitude be pretty nearly known, by ſolving the Problem by the Planiſpheres, they will ſhew whether it is above or under the Horizon at the Hour and Minute when ſuch Eclipſe or Appulſe happens. 2. If the Obſerver is quite unacquainted with the Longitude he is in, the firſt clear Evening will diſcover to him the Poſition of the Satellite or fixed Star to the Planet, whether it be *Jupiter* or the *Moon*, and its Diſtance from the Planet will help the Obſerver to determine whether or no ſuch particular Eclipſe or Appulſe will happen whilſt the Planet is above the Horizon in that Place of Obſervation. 3. If an Appointment be made previous to a Series of ſuch Obſervations, at the principal Places throughout the known World, the geographical Situation of Places may be more exactly ſettled, than they can ever be expected to be by moſt other Ways. 4. To find all thoſe Places, where any Eclipſe or Appulſe will be viſible by the Planiſpheres. Find that Place of the Earth where the Planet will be vertical at the Time of the Eclipſe or Appulſe, and 90° Diſtance therefrom, all round the Place where the Planet is vertical, the Eclipſe or Appulſe may be ſeen if the Sky is clear and no Part thereof comes into the Sun's enlightened Hemiſphere. Therefore, find where the Sun is vertical at the ſame Time, and alſo all that Space within 90 Degrees Diſtance round the Place where the Sun is vertical; for to that Part of the Sun's enlightened Hemiſphere which interferes with the Planet's illuminated Hemiſphere, the Eclipſe or Appulſe will be inviſible, but to all the other Parts viſible. 5. What has been here obſerved with Reſpect to the Eclipſes of *Jupiter*'s Satellites, and Appulſes of the Moon to the fixed Stars, is alſo applicable to the Appearance of a Comet, when its Place in the Heavens is known.

Several other Problems might be enlarged upon; but we think it quite needleſs, having aimed at Perſpicuity without Prolixity, throughout this Treatiſe.

And, whereas, ſeveral Inconveniencies have ariſen ſince the firſt Publication of theſe Planiſpheres for Want of the Author's having convenient Opportunity to fit them up himſelf (notwithſtanding which Diſadvantages, they have been highly approved of by eminent Mathematicians), therefore, for the future, they are to be fitted up under the Author's own Direction, in the following Manner: On Paper or Cloth, for the Pocket, Library, or at Large, at a reaſonable Expence for colouring, or other additional Ornaments. 1. Each Planiſphere will have a String thro' its Centre, for Problems which require no more than the Application of a Right Line from the Centre to the Circumference, ſuch as relate to the Hour of Sun-riſing and ſetting, Length of the Day and Night, Azimuth, and Altitude at Six, &c. 2. Every Sett of Planiſpheres will have two Sliders of a permament, gloſſy, tranſparent Paper, but little inferior to Glaſs itſelf, when preſſed cloſe on the Planiſphere; one of which Sliders will be divided into four Parts for the Convenience of ſolving a great Number of Problems, ſome without looking thro' the Slider, and others very near its Edge; the other whole Slider to be divided in like Manner, if any Accident ſhould happen to the divided one. 3. The divided Slider will be cut from Z to N, reſerving one half for Problems which require more than 90 Degrees of the Arch of a Meridian or Great Circle, and the other Half cut into two equal Parts or Quadrants, one of which Quadrants will be cut along the Parallel of 18 Degrees for Problems of the Twilight, Zodiac, or within 18 Degrees of the Horizon; and the other Part of this Quadrant will have a Centre fixed to it for Problems from the Zenith or Nadir to 18 Degrees above or below the Horizon, ſuch as the Altitude, Azimuth, Hour-angle, &c. either Side of the Slider being applicable to the Planiſphere, as the Nature of the Problem ſhall require; and the other Quadrant to be cut in like Manner if wanted.

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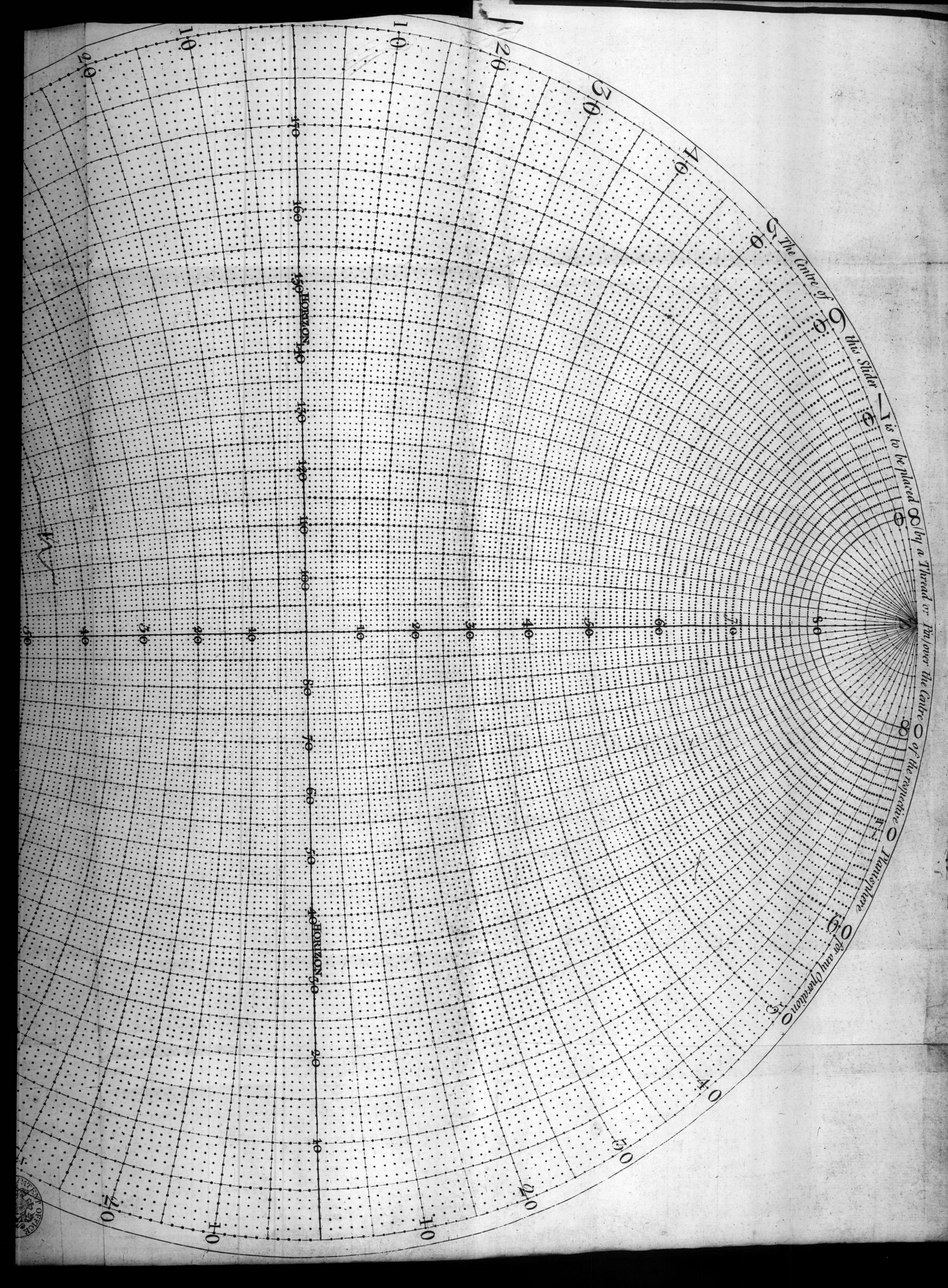

The Centre of this Slider is to be placed by a Thread or Pin over the Centre of the respective Planisphere for any Operation

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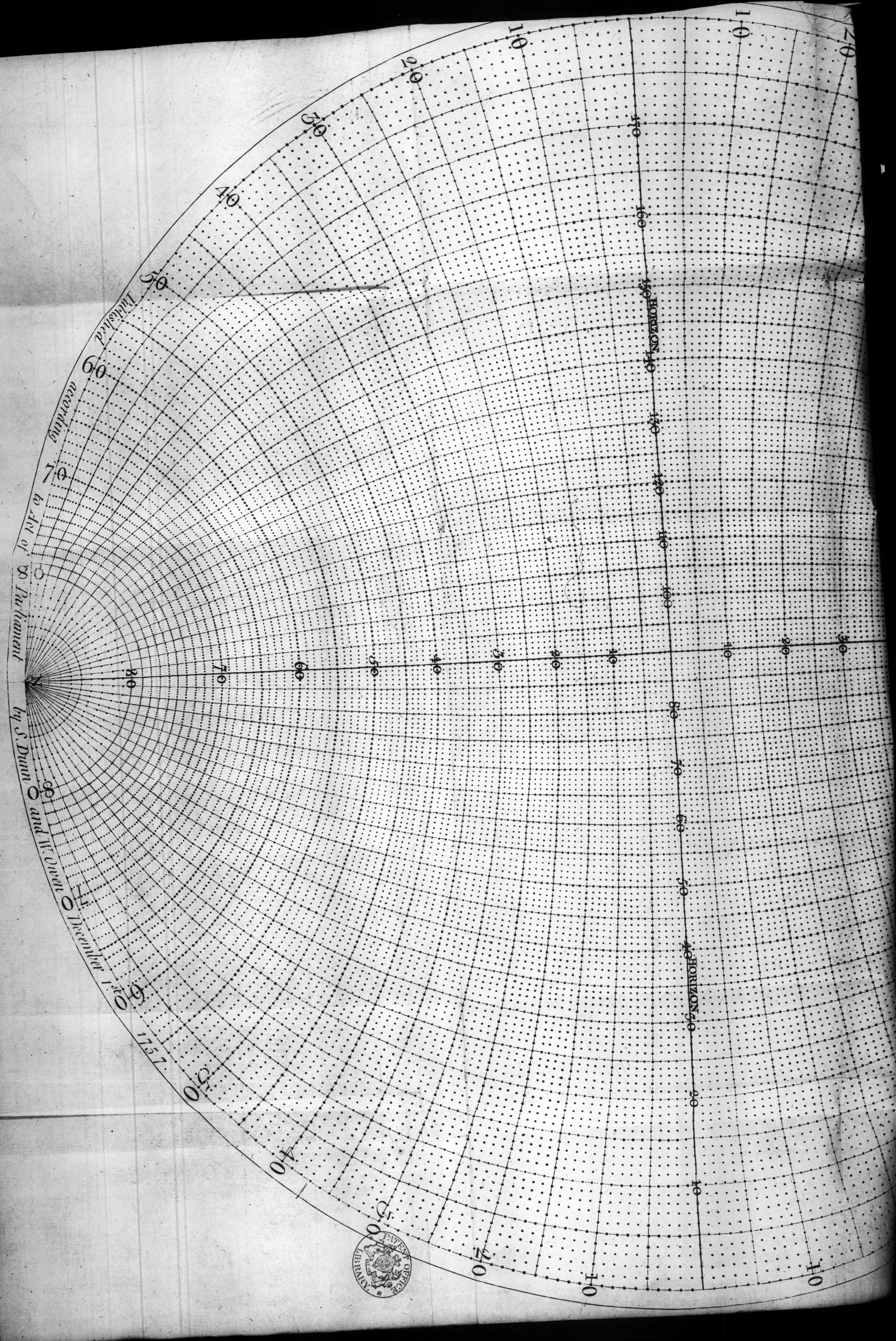

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THE SOLAR SYSTEM.

1. BEFORE we proceed to ſhew the Uſes of the Univerſal Planiſpheres, two of which together do repreſent the terraqueous Globe, and the other two the ſtarry Firmament or Heaven. We think it may not be improper to introduce an Account of the Univerſe in general, and of the ſolar Syſtem in particular, of which theſe Planiſpheres do repreſent a Part.

2. By the Word UNIVERSE we here underſtand the whole Frame and Extent of Nature, from the moſt minute Particles of Bodies which we can perceive to exiſt by our Senſes, throughout all thoſe various Claſſes of Matter, and the innumerable Multitude of Stars or Suns, which are too far diſtant from us for our Underſtandings to comprehend.

3. Seeing that when we have extended our Enquiries into the intrinſic Nature of Things, as far as we are able, we find all that Variety which is perceived in the Univerſe, to ariſe from the Properties of Bodies, and the Laws with which they are endowed; it muſt therefore be allowed as quite ſatisfactory to have reduced any natural Phenomenon to its primitive Laws and Conſtitutions in Nature.

4. The Laws which we find all Bodies endeavouring to obſerve, are, 1ſt, To continue in their preſent State, whether of Reſt or forward uniformly in a right Line, until they are compelled to change that State, by ſome other Force acting on them, and this Endeavour is ſometimes called the VISINERTIÆ of Matter. 2d. The Mutation or Change of Motion from one Direction to another is always proportional to the Force engaged in changing the ſame, and is made in the Direction of that right Line in which the Force is impreſſed; which if toward ſome Centre is called *Gravity*, and ſometimes *Attraction*. 3d.

Action and Reaction are always mutual and equal to each other, or the Actions of two Bodies upon each other, are always equal and in contrary Directions.

5. Gravity is a Property which we find no Bodies on our Earth to be deſtitute of, therefore we may conclude, that this is a Property of all Bodies whatſoever. By this Property we find that Bodies have Weight, that when they are let fall they deſcend freely through Space toward the Earth; by this Property we alſo find that the minute Particles of Matter coming very near to each other, do abſolutely join and ſtick faſt together, ſo as not to be eaſily ſeparated, and that the great Globes of the Sun and Planets, although at great Diſtances from each other, do attract with Powers proportional to their Quantities of Matter, from which we may reaſonably infer that this Law holds not only throughout our ſolar Syſtem, but alſo through the Univerſe.

6. Elasticity or Repulsion is another Property which we find in ſome particular Bodies, but cannot diſcern its Origin; by this we ſee that when elaſtic Subſtances have been compreſſed, and are let looſe, they immediately return to their former Situation, retaining the ſame Force with which they yielded. Indeed we know that this Property becomes very powerful in oily, airy, and watery Subſtances, when they have been potently heated by Fire; and that the Subſtances of Earths and Salts receive no ſuch Activity from the ſame Agent, but why ſuch different Effects ſhould be produced by the ſame Cauſe, the moſt accute Naturaliſts have not been able as yet to underſtand.*

7. It

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* It ſeems probable to me (ſays Sir Isaac Newton,) that God in the Beginning formed Matter in ſolid, maſſey, hard, impenetrable, moveable Particles of ſuch Sizes and Figures, and with ſuch other Properties, and in ſuch Proportion to Space as moſt conduced to the End for which he formed them, and that thoſe primitive Particles, being Solids, are incomparably harder than any porous Bodies compounded of them, even ſo hard as never to wear or break in Pieces, no ordinary Power being able to divide what God himſelf made One in the firſt Creation.

While the Particles continue entire, they may compoſe Bodies of one and the ſame Nature and Texture in all Ages, but ſhould they wear away or break in Pieces, the Nature of Things depending on them would be changed. Water and Earth compoſed of old worn Particles and Fragments of Particles, would not be of the ſame Nature and Texture now, with Water and Earth compoſed of entire Particles in the Beginning. And therefore, that Nature may be laſting the Changes of corporal Things, are to be placed only in the various Separations, and new Aſſociations and Motions of theſe per-

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7. It is probable that the Univerſe contains an innumerable Multitude of ſolar Syſtems, of which the fixed Stars appear to be ſo many Centres; for the Light of theſe Stars is of the ſame Kind with that of our Sun, and was he removed to ſo great a Diſtance from us as they are, he would appear like a Star as they do, and all the other Bodies in our ſolar Syſtem, being opake Ones, would not be viſible at ſo great a Diſtance; and therefore theſe Syſtems cannot interfere with one another, whilſt they are duly regulated by the Laws of Matter, although they be innumerable, and their Bounds and Extent too great for human Reaſon to comprehend.

8. We find that the ſolar, mundane, or PLANETARY SYSTEM, contains Seventeen great Bodies nearly ſpherical, one of which only ſhines by his own native Light, the other Sixteen being opake and appearing only by the Light which comes from that luminous one. The intermediate or intermundane Spaces between thoſe Bodies being either void of all Matter, or if there be any, it is ſo very thin and ſubtile, as to have made no ſenſible Reſiſtance on the Motions of thoſe Bodies from the firſt Ages of Time: The Planets and Comets appearing to move in free Spaces, and being actuated by no other Laws, but that of Gravitation toward each other, in Proportion to the Quantities of their Matter, and their Viſinertiæ ariſing from a projectile Force, which they muſt have received from ſome powerful Agent.

9. The SUN is placed near the Centre of this Syſtem, and moves with a very ſmall Agitation or Motion compared with the Motion of the Planets, and all the Planets and Comets move

permanent Particles, compound Bodies being apt to break, not in the midſt of ſolid Particles, but where thoſe Particles are laid together, and only touch in a few Points.

It ſeems to me, farther, that theſe Particles have not only a Viſinertiæ accompanied with ſuch paſſive Laws of Motion, as naturally reſult from that Force, but alſo that they are moved by certain active Principles, ſuch as is that of Gravity, and that which cauſeth Fermentation and the Coheſion of Bodies. Theſe Things I conſider not as occult Qualities ſuppoſed to reſult from the ſpecific Forms of Things, but as general Laws of Nature by which the Things themſelves are formed; their Truth appearing to us by Phenomena, though their Cauſes be not yet diſcovered.

Now by the Help of theſe Principles, all material Things ſeem to have been compoſed of the hard and ſolid Particles abovementioned, variouſly aſſociated in the firſt Creation, by the Counſel of an intelligent Agent. For it became him who created them to ſet them in order. And if he did ſo, its unphiloſophical to ſeek for any other Origin of the World, or to pretend that it might ariſe out of a Chaos by the mere Laws of Nature. Thus far Sir *Iſaac Newton*.

round him. He is a Body of Fire, partly liquid and partly ſolid, the liquid Part being an inexhauſtible Ocean of Light, moving with firy Billows and flaming Ebullitions, continually diffuſing innumerable Corpuſcles of elementary Fire and Light to the utmoſt Bounds of the planetary Syſtem. The ſolid Parts appear like Continents, Iſlands, Mountains, and Rocks of Fire, with vaſt ſubterraneous Caverns and Receptacles, containing the fluid and liquid Parts, and which break forth in ignivomous Fumes when the Sun is more than uſually hot on his Surface.

10. On the Sun's Diſque or Face, are often ſeen dark Spots called Maculæ, their Shapes and Sizes are uncertain and irregular, ſometimes appearing numerous for an Age together, and at other Times diſappearing for ſo long a Time. They have all a Motion from the Eaſt-ſide of the Sun's Diſque to the Weſt, in a direct Paralleliſm with the Sun's Equator, from which it is concluded, that they are floating Droſs on the ſolar Ocean, and that the Sun moves round his Axis with them, for they ſometimes ſoon accumulate and at other Times as ſoon diſſolve, it being very rarely that theſe Maculæ make more than one Revolution before they diſappear.

11. Each of the primary Planets, namely, *Mercury*, *Venus*, our *Earth*, *Mars*, *Jupiter* and *Saturn*, move round the *Sun* as their Centre, and in Orbits which are elliptical and may be thus deſcribed. Seal down a ſquare Piece of white Paper on a flat Board, and drive two Pins through the Paper into the Board, at the Diſtance of one, two, or three Inches from each other, near the Middle of the Paper; tie a Thread round the two Pins, ſo that when it is tied, and double, it may be two or three Inches longer than the Diſtance of the two Pins: Then hold a Pencil or Pen upright within the Thread whilſt it is ſtretched tight, and carry round the Pencil or Pen, marking its Trace on the Paper, this will not be a Circle but an Ellipſis, like the Orbit deſcribed by a Planet whilſt it is moving round the Sun.

12. The two Pins are called the two Foci of the Ellipſis, at one of which the Sun is ſuppoſed to be placed as at Centre: Half the Diſtance between the two Foci is called the Eccentricity of the Planet. The Line paſſing through the two Foci from one Side of the Orbit to the other, is called the tranſverſe Diameter of the Orbit. A Line drawn from one Side of the Orbit to the other, and paſſing at right Angles through the Middle of the tranſverſe Diameter, is called the conjugate Diameter of the Orbit: When the Planet is fartheſt diſtant from

the Sun, it is ſaid to be in its Aphelium, and when it is neareſt to the Sun, it is ſaid to be in its Perihelium: The Aphelium is ſometimes called the lower Apſides, and the Perihelium the higher Apſides of the Orbit. When the Planet is at its greateſt Diſtance from the Earth, it is ſaid to be in Apogeon, and when neareſt the Earth, in Perigeon.

13. The Orbit deſcribed by the Earth in its Motion round the Sun, is called the Ecliptic, and as the other Planets whilſt they are moving round the Sun, do not move in the Plane of the Ecliptic, they muſt ſometimes be above, and at other Times as much below this Plane. The Points in which the Orbits of the other Planets, cut the Plane of the Ecliptic, are called the Nodes, ſo there will be two Nodes in every Orbit, and the Line which joins theſe Nodes, is called the Line of the Nodes. That Node where the Planet aſcends to the North from below the Ecliptic, is called the aſcending Node, and that Node where the Planet deſcends to the South below the Ecliptic, is called the deſcending Node.

14. The Planets move faſteſt in their Orbits when they are neareſt to the Sun, and ſloweſt when they are fartheſt from the Sun, and whilſt they are moving forward in their Orbits, are turning round their own Centres, under the ſame Direction as they move in their Orbits, which Motion is called in Conſequentia, but a Motion contrary thereto, is ſaid to be in Antecedentia. The Line paſſing through the Centre of the Planet, and about which it moves, is called its Axis: The Extremities of the Axis, are called the Poles. Thoſe Planets which are nearer the Sun than our Earth, are called inferior Planets, as *Mercury* and *Venus*, and thoſe Planets which are farther from the Sun than our Earth, are called ſuperior Planets, as *Mars*, *Jupiter*, and *Saturn*.

15. The Squares of the periodic Times, are as the Cubes of the Diſtances from the Sun for all the primary Planets. If two right Lines be drawn from the Sun to different Points of the Orbit, the Time which the Planet has taken in paſſing from one of theſe Points to the other, will always be proportionable to the Area or plain Surface contained between theſe two Lines and the Arch of the Orbit. The Velocity of a Planet in any Point of its Orbit, is always inverſely as its Diſtance from the Sun. The Force with which any Planet gravitates toward the Sun in any Point of its Orbit, is always as the Square of its Diſtance from the Sun. The Axis of every primary Planet keeps nearly the ſame parallel Poſition whilſt it is moving in its Orbit.

16. All the Planets appear to move from Eaſt to Weſt, or to riſe and ſet in 24 Hours, by the Rotation of the Earth round its Axis in that Time, but they really move from Weſt to Eaſt. Sometimes they appear to have gained from Weſt to Eaſt in 24 Hours, and then their Motion is ſaid to be direct: Sometimes they appear to have gained from Eaſt to Weſt in 24 Hours, and then their Motion is ſaid to be retrograde, at other Times they appear to be in the ſame Place during 24 Hours, and are then ſaid to be Stationary. All which muſt neceſſarily ariſe from the Motion of the Earth in its Orbit, and the Direction and Motion of the other Planets in their Orbits.

17. The Inclination of the Planet's Orbit to that of the Ecliptic, is called its Obliquity. The Diſtance from the Planet to the Plane of the Ecliptic, is called its Latitude. The Diſtance of a Planet from its Node, is called the Argument of Latitude. The Latitude as ſeen from the Sun, is called the heliocentric Latitude; and the Latitude as ſeen from the Earth, is called the geocentric Latitude. The true Diſtance of the Planet from the Sun, is called the curtate Diſtance. The Angle made by two right Lines drawn from the Earth to the Sun and Planet, is called the Angle of Elongation. The Angle which is made by two right Lines drawn from the Planet to the Earth and Sun, is called the parallactic Angle. And the Angle which is made by two right Lines drawn from the Sun to the Earth and Planet, is called the Angle of Commutation.

18. What hath been here ſaid of the Planets and their Orbits, is alſo obſervable in the Comets and their Orbits; for they are obſerved to move in free Spaces round the Sun, and in Orbits no Way different from thoſe of the Planets, but very excentric, whereby their Perihelia come near the Sun, and their Aphelia are more diſtant from him, and therefore theſe Bodies muſt ſuffer great Extreams of Heat and Cold.

19. The ſecondary Planets (of which there are known to be Ten, namely, one *Moon* revolving round our *Earth*, four Moons or Satellites moving round *Jupiter*, and five Moons or Satellites moving round *Saturn*) do alſo obſerve the ſame Laws toward their primary Ones, as the primary Planets obſerve toward the Sun; and therefore whatever hath been mentioned of them, is alſo to be underſtood in like Manner of theſe.

20. MERCURY is the firſt and neareſt Planet to the Sun, he appears red and firy, an opake Body receiving all his Light from the Sun, nearly round, having many Hills and Mountains:

tains: He is ſometimes ſeen like a full Moon, ſometimes horned, and at other Times gibbous. He has ſeveral Spots, ſome of which are light, and others duſkiſh, which may be Mountains and Seas. On Account of his Nearneſs to the Sun, he hath a very great projectile Force, for his gravitating Force is very great, and his Orbit would otherwiſe be very eccentric, and therefore, by moving with a rapid Velocity, he is prevented from being ſnatched into the ſolar Blaze. The Heat which he continually receives from the Sun, would make Water Boil on the Surface of our Earth, and was he not a very denſe Body, would be calcined by the ſolar Heat. He is ſeldom ſeen by the naked Eye, and then a little after Sun-ſetting or before Sun-riſing, on Account of the Smallneſs of his greateſt Elongation, and the Light of the Sun to which he is always adjacent. In his Paſſage between the Sun and our Earth, he appears like a dark Patch on the ſolar Diſque, with his Circumference ſomewhat red. He is a ſmall Planet, and other Particulars concerning him, are contained in the following Tables.

21. Venus is the ſecond Planet in the ſolar Syſtem, ſhe moves round the Sun at a greater Diſtance than *Mercury*, and next below our Earth, to which ſhe is equal in Magnitude, tho' a little more denſe. She is a bright and glittering Planet, the moſt regular Planet in her Motions of the whole ſolar Syſtem, which is owing to her ſmall Excentricity; ſhe receives twice the Light and Heat from the Sun that we do, is ſometimes very near the Earth, and then is often ſeen in the Day time, and caſts a Shadow in the Night like the Moon, and on Account of her Proximity to the lunar Orbit greatly diſturbs the Motion of that Luminary. She is ſometimes the Morning ſtar riſing before the Sun, at other Times, the Evening ſtar ſetting after the Sun; has the ſame Variety of Changes as the Moon, ſometimes appearing full, ſometimes horned, and at other Times gibbous. She has a rough and uneven Surface, and probably Lands and Seas like our Earth, is ſometimes ſeen in the Face of the Sun, and then appears like a dark Patch much larger than *Mercury*. It is not certain that ſhe has any Moons or Satellites accompanying her, although ſeveral Aſtronomers have thought to have diſcovered one: If ſhe has any, their Surface may be too opake to reflect Rays to the Diſtance of our Earth. Other Particulars relating to this Planet, are contained in the following Tables.

22. The EARTH, upon whoſe Surface we dwell, is the third Planet in the ſolar Syſtem, it is a Body nearly round, moves round the Sun in a Year, in an Orbit between that of *Venus* and *Mars*, its Orbit is called the ECLIPTIC, and is divided into 12 Signs, *Aries* ♈, *Taurus* ♉, *Gemini* ♊, *Cancer* ♋, *Leo* ♌, *Virgo* ♍, *Libra* ♎, *Scorpio* ♏, *Sagittarius* ♐, *Capricorn* ♑, *Aquarius* ♒, *Piſces* ♓; each Sign containing 30 Degrees. Theſe Signs are counted forward according to the Direction of the Earth in its Motion through the Ecliptic; and this is ſaid to be from Weſt to Eaſt, or according to the Order of the Signs. Beſides this annual Motion, the Earth hath another Motion round its own Axis once a Day from Weſt to Eaſt, by which quick Rotation, the Sun, Planets, and fixed Stars, appear as though they did riſe and ſet from Eaſt to Weſt in the ſame Time. Moreover, the Plane of the Earth's Equator keeps the ſame parallel Poſition to itſelf, whilſt it is moving round the Sun, and this Plane is always inclined to the Plane of the Earth's Orbit or Ecliptic under an Angle of $23\frac{1}{2}$ Degrees, by which Means there are two Points in the Earth's Orbit or Ecliptic, in one of which the Earth will revolve round its Axis, having its northern Regions much expoſed to the Sun, and its ſouthern Regions as little expoſed at the ſame Time, and in the other of theſe Points, the Earth's ſouthern Regions will be much expoſed, whilſt the northern Regions are as little expoſed to the ſolar Rays; and theſe two Points are the Places of the Earth at the Summer and Winter Solſtices reſpectively, as the intermediate Points of the Orbit oppoſite to each other are the Places of the Earth at the vernal and autumnal Equinoxes, and hence the Viciſſitudes of the Seaſons and the various Lengths of Days and Nights at different Times of the Year, at different Places on the Earth's Globe.

23. Our *Earth* hath an inviſible light, fluid, thin, elaſtic Subſtance ſurrounding it, called its ATMOSPHERE, which freely fills its Pores, and extends to the Height of about 50 Miles. The Denſity and Weight of this Atmoſphere decreaſeth as its Height increaſeth. It is ſo dry and elaſtic as never to congeal or become ſtagnant as Water doth into Ice or Snow. Without this Atmoſphere, ſonorous Bodies could not be heard, Odours could not be ſmelt, nor could the Rays of Light be refracted to our Eyes in coming from the Sun. Hereby the Lungs receive a freſh Supply of that vivifying Spirit which animal Life deſtroys. This Atmoſphere expands greatly with the Preſence of

the Sun, condenſeth in his Abſence, produceth all theſe Changes of Beauty and Variety in the vegetable Creation which we have in Summer and Winter, is an univerſal Cement for all Bodies, and a Menſtruum for reducing all Things to other Forms by Duration and Time.

24. By the Weight, Elaſticity and Rarefaction of the Earth's Atmoſphere, great Quantities of Water are exhaled from the Seas, Rivers and Lakes by the Heat of the Sun, particularly where he is nearly vertical, and the Atmoſphere is rare; theſe Exhalations, form Clouds, conſiſting of aqueous, ſulphureous and ſaline Particles, which, when they take Fire in the Air, break out with that Violence of Light and Noiſe which we obſerve in Lightning and Thunder. Of the ſame Compoſition are all Fogs and Miſts near the Earth's Surface, which want nothing to make them Clouds in the higher Regions of the Air, but a more denſe Atmoſphere to ſwim in. Thus the Air or Atmoſphere is a pellucid Menſtruum for the inſenſible Parts of diſſolved Bodies to float up and down in, until they come to a Medium ſpecifically lighter than themſelves, when they deſcend freely, being ſubjected to no other Laws but that of Gravity to each other and the Earth, and therefore form themſelves deſcending, into Drops of Rain. When the Atmoſphere is more replete with nitrous Particles, and leſs replete with ſulphureous Ones, the Attraction between the nitrous and aqueous Particles will be greater than the repulſive Power, and therefore the former will wholly overcome the latter, and the Fluid will become criſtallized and ſtagnant, and this in Clouds or Drops of Rain deſcending through colder Regions of the Air, or intercepted by freezing Winds and warmer Air, firſt gently criſtallizes, then gently thaws, and ſticks together, falling in Fleeces of Snow. And thus when the Particles are more nitrous, or the Cold more intenſe, Hail is formed. When ſulphureous and nitrous Vapours exhaled above the Clouds take Fire, they aſcend upward as toward the Zenith or Point over our Heads, and form the Phenomenon of the Aurora Borealis, or northern Lights; when ſuch Vapours are fired near the Earth's Surface, they waft to and fro with the Wind, and form the Ignis Fatuus, or Jack with a Lanthorn; and when they kindle above the Clouds in ſerene Air, or long Trains, they form the Phenomena of ſhooting or falling Stars. The vivid Colours of the Rain-bow, are alſo formed of the primary and conſtituent Corpuſcles of Light falling on ſmall Drops of Water,

from which they are reflected and refracted to our Eyes, and excite the Senſation of thoſe Colours of Light in the Atmoſphere.

25. The deeper Valleys of our Earth are filled with vaſt Oceans and Seas, or Waters ſtretching round the Globe, the Extent of theſe Waters is much greater than that of the Lands, their Depths and Irregularities ſomewhat proportionable to the Heights of the Mountains, with which they are generally found to compare. Great Plenty of Salt is found in theſe Waters, ſuppoſed to be diſperſed over the Bottom of the Ocean, and to commix by Dilution. Theſe Seas riſe or ſwell above their uſual Surface, twice every Day, which is when the Moon is either South or North on the Meridian. Theſe Swells cauſe the Waters of the Ocean to flow up the narrow Seas, Channels and Rivers, which ſtriking againſt irregular Shores that lie in their Way, are variouſly reſiſted until they have reduced thoſe Rivers to even Heights with the general Swell, which ſometimes requires ſeveral Hours to accompliſh after the Moon is paſt the Meridian. All which is a neceſſary Conſequence of the Gravitation of theſe Waters toward the Moon; for as ſhe is much nearer to the Earth than any of the Planets beſide, and the Particles of Water are globular and eaſily to be ſeparated, the Waters, where the Moon is vertical, will gravitate toward her with a greater Force, than thoſe Waters which are diametrically oppoſite on the other Side of the Earth's Globe, the intermediate Seas will gravitate leſs than the former, but more than the latter, and the Waters where the Moon is vertical, and thoſe on the oppoſite Side of the Earth, will be raiſed above their uſual Surface, nearly equal; for the Centre of the Earth itſelf, gravitates toward the Moon, and the Gravitation of all its Parts, toward each other, are mutual and equal. When the Sun's Attraction is conjoined with that of the Moon, which is the Caſe when the Sun and Moon are in Conjunction or Oppoſition, that is, in a Line with each other, the Tides will then be higher, and theſe are called Spring-tides, but when the Moon is in her Quadratures, or a Quarter of her Orbit from the Sun, the Force of the Moon's Attraction will be leſſened by that of the Sun, and theſe Tides are called Neap-tides. Currents or particular Settings of the Ocean ariſe from theſe and other like accidental Cauſes.

26. The Tranſition of the Atmoſphere from one Place to another, or which is the ſame Thing, the Motion of the Air, is the immediate Cauſe of Winds in all their Kinds. Theſe are oc-

occaſioned by the Rarefaction and Condenſation of Vapours, the Preſſure of the Clouds, Deſcent of Rain, Snow and Hail, and other like accidental Cauſes. Theſe Winds which blow in the larger Oceans, between, and near the Tropics, or where the Sun is nearly vertical at any Time of the Year, do conſtantly blow from Eaſt to Weſt, becauſe the Sun is conſtantly rarifying the Atmoſphere that Way, and the ſubſequent adjacent Atmoſphere is continually preſſing the ſame Way to preſerve an Equilibrium. The Moon alſo attracts the Atmoſphere from Eaſt to Weſt, and theſe Winds are called conſtant, or Trade-Winds. In leſſer Oceans, variouſly environed with Lands, the Winds will be variouſly interrupted, and their natural Directions altered by the ſuperior Heat of the Sun on the terreſtrial Parts of the Earth's Globe, on which Account there are frequent Sea and Land Breezes near the Shores, and therefore the Winds in ſuch Seas, do blow ſome Part of the Year one Way, and the other Part of the Year another Way, and theſe are called Monſoons, or periodical Winds.

27. By Means of the Earth's Atmoſphere, Springs and Rivers are furniſhed with a continual Supply, for as Rains deſcend, and fill the Crevices, Channels and Veins of the Earth, and Clouds are exhaled from the Earth and Sea, and the Winds waft theſe Clouds to the Sides of Mountains, the Clouds are attracted by the Mountains and run down into the Vallies forming Rivers. Waters accidentially lodged under Mountains, are attracted upward through the Pores and ſpungy Parts of the Earth, and preſſed out in Springs, which deſcend by their Sides, and carry various Particles of Sulphur, Nitre, Earth, or Minerals with them, and hence are formed Mineral Waters. Air condenſed within the Earth, guſheth forth into a more rare Atmoſphere, and brings great Streams and Torrents of Water with it. Theſe Waters form Rivers, and run to the Ocean.

28. On the Surface of the terraqueous Globe, and below its Surface, are found a great Variety of different Kinds of Bodies, variouſly mixed and diſpoſed, ſome of which give rooting to Plants, others are medicinal, and others curious. Among theſe are Sand, Gravel, Chalk and Rocks which are barren; Clays and Mould, or Garden Earth, producing moſt Things neceſſary for animal Suſtentation. Below the Surface of the Earth, are found various Foſſils, or Compoſitions partaking of Earth and Stone; of which Kind are Oker, Chalk and ſoft Leads. Stones of various Kinds, as Marble, Porphyry, Freeſtone, Flint,

Agate, Cornelian, Pebble; Diamonds, Rubies, Amethyſts, Emeralds; Limeſtones, Whetſtones, and many others, with the Loadſtone, whoſe peculiar Property is to direct itſelf nearly North and South, when ſuſpended freely, and to give Iron or Steel the ſame Direction by a ſlight Touch, but this Direction changeth in Time.

29. The Earth hath alſo ſeveral Sorts of Salts, among which are common Salt, Vitriol and ſalt Gemma, alſo Minerals or Semi-metals, as Antimony, Cinnabar, Zink and Brimſtone. But the Bodies of greater Value, dug out of the Earth, are uſually diſtinguiſhed by their Weight, Fuſibility and Malleability, as Lead, Tin, Copper, Iron, Silver, Gold and Quickſilver.

30. The Structure and Conſtitution of the Earth's Globe toward its * Centre, is entirely unknown to us for certain, and per-

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* Dr. *Halley*'s Opinion hereof is as follows: Now (ſaith he) to propoſe ſomething that may anſwer the ſeveral Appearances, and introduce nothing ſtrange in Philoſophy, after a great many cloſe Thoughts, I can come to no other Concluſion, than that the whole Globe of the Earth is one great Magnet, having four magnetical Poles or Points of Attraction, near each Pole of the Equator two; and that in thoſe Parts of the World which lie near adjacent to any one of thoſe magnetical Poles, the Needle is governed thereby, the neareſt Pole being always predominant over the more Remote.

The Parts of the Earth wherein theſe magnetical Poles lie, cannot as yet be exactly determined for Want of ſufficient Data to proceed geometrically. And this Hypotheſis is ſufficient for ſolving the great Variety and ſeeming Irregularity, which is obſerved in the Variations of the Compaſs. But to calculate exactly what the Variation is in any Place aſſigned, is what I dare not yet pretend to, tho' I could wiſh it were my Happineſs to be able to oblige the World with ſo uſeful a Piece of Knowledge; there are Difficulties that occur, that render the Thing as yet not feaſible, for firſt, there are a great many Obſervations requiſite, which ought to be made at the ſame Time, not at Sea but aſhore, with greater Care and Attention than the Generality of Sailors apply. And beſides, it remains undetermined in what Proportion the attractive Power decreaſes, as you remove from the Pole of a Magnet, without which it were a vain Attempt to go about to calculate. There is yet a further Difficulty, which is the Change of the Variation, one of the Diſcoveries of this laſt Century, which ſhews that it will require ſome Hundreds of Years to eſtabliſh a compleat Doctrine of the magnetical Syſtem.

Now conſidering the Structure of our terraqueous Globe, it cannot be well ſuppoſed that a very great Part thereof can move within it, without notably changing its Centre of Gravity and the Equilibre of its Parts, which would produce very wonderful Effects in changing the Axis of diurnal Rotation, and occaſion ſtrange Alteration in the Sea's Surface, by Innundations and Receſſes thereof, ſuch as Hiſtory never yet mentioned. Beſides, the ſolid Parts of the Earth are not to be granted permeable by any other than fluid Subſtances, of which we know none that are any Ways magnetical. So that the only Way to render this Motion intelligible and poſſible, is to ſuppoſe it to turn about perhaps for ever will be. Indeed, by Sir *Iſaac Newton*'s Diſcoveries, we know that if our Earth be an homogeneous Solid of equal Denſity throughout, that the Force of Gravity diminiſhes downward toward its Centre in Proportion to the Diſtance, and that at the Centre it becomes nothing at all, and therefore Bodies are there void of all Gravity with Reſpect to the Earth. Alſo, we know, that if the Earth's Globe was a hollow Sphere with an indefinitely thin Surface, a Particle of Matter placed any where within that Surface, would not be attracted toward the Centre nor under any other Direction. We alſo know, that the Denſity of the Earth, compared with its Magnitude, is leſs than the Denſity of ſome other Planets of the ſolar Syſtem, compared with their Magnitudes. And therefore there is no Inconſiſtency in ſuppoſing the Earth to be hollow toward its Centre,

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about the Centre of the Globe, having its Centre of Gravity fixed and immoveable in the ſame common Centre of the Earth. And there is yet required, that this moving internal Subſtance be looſe and detached from the external Parts of the Earth whereon we live; for otherwiſe were it affixed thereto, the Whole muſt neceſſarily move together.

So then the external Parts of the Globe may well be reckoned as a Shell, and the internal as a Nucleus or inner Globe included within ours, with a fluid Medium between, which having the ſame common Centre and Axis of diurnal Rotation, may turn about with our Earth each twenty-four Hours; only this outer Sphere having its turbinating Motion ſome ſmall Matter either ſwifter or ſlower than the internal Ball: And a very Minute difference in Length of Time, by many Repetitions becoming ſenſible, the internal Parts will by Degrees recede from the external, and not keeping Pace with one another, will appear gradually to move either Eaſtwards or Weſtwards by the Difference of their Motions.

Now ſuppoſing ſuch an internal Sphere having ſuch a Motion; if this exterior Shell of Earth be a Magnet, having its Poles at a Diſtance from the Poles of diurnal Rotation; and if the internal Nucleus be likewiſe a Magnet, having its Poles in two other Places diſtant alſo from the Axis; and theſe latter by a gradual and ſlow Motion, change their Place in Reſpect of the external; we may then give a reaſonable Account of the four magnetical Poles I preſume to have demonſtrated before; as likewiſe of the Changes of the Needle's Variations, which till now hath been unattempted.

The Period of this Motion being wonderful great, and there being hardly an hundred Years ſince theſe Variations have been duly obſerved, it will be very hard to bring this Hypotheſis to a Calculus, eſpecially ſince though the Variations do increaſe and decreaſe regularly in the ſame Place, yet in different Places at no great Diſtance, there are found ſuch caſual Changes thereof, as can no Ways be accounted for by a regular Hypotheſis, as depending upon the unequal and irregular Diſtribution of the magnetical Matter, within the Subſtance of the external Shell or Coat of the Earth, which deflect the Needle from the Poſition it would require from the Effect of the general Magnetiſm of the Whole.

Hence

Centre, and there poſſeſſed of Fire, Water, Vapour, or a Void.

31. Vegetables and Plants are plentifully produced on our Earth; of theſe there are various Kinds, as Herbs having ſoft and tender Stalks, but no Wood or hard Subſtance; Shrubs which grow near the Earth's Surface, and Trees which grow high and wide. Moſt of theſe have Root, Stalk, Leaf, Flower and Seed, and are all nouriſhed by the Juices imbibed by the ſmaller Fibres of the Roots, from which they are conveyed thro' very minute Tubuli to the Stalks, Branches and Leaves, from which theſe Juices return in like Manner through the Bark to the Root. All which muſt neceſſarily be on the Rarefaction and Condenſation of the Atmoſphere in Summer and Winter.

32. Ani-

Hence, and from ſome other of like Nature, I conclude that the two Poles of the external Globe are fixed in the Earth, and that if the Needle were wholly governed by them, the Variations thereof would be always the ſame, with ſome little Irregularities, upon the Account I but juſt now mentioned: But the internal Sphere having ſuch a gradual Tranſlation of its Poles, does influence the Needle, and direct it variouſly according to the Reſult of the attractive or directive Power of each Pole, and conſequently there muſt be a Period of the Revolution of this internal Ball, after which the Variations will return again as before. But if it ſhall in future Ages be otherwiſe obſerved, we muſt then conclude there are more of theſe internal Spheres, and more magnetical Poles than four, which at preſent we have not a ſufficient Number of Obſervations to determine.

If this be allowed me, 'tis plain that the fixed Poles are the Poles of this external Shell or Cortex of the Earth, and the other two the Poles of a magnetical Nucleus, included and moveable within the other. It likewiſe follows, that this Motion is Weſtwards, and by Conſequence that the aforeſaid Nucleus has not preciſely attained the ſame Degree of Velocity with the exterior Parts in their diurnal Revolution; but ſo very nearly equals it, that in 365 revolves, the Difference is ſcarce ſenſible. This I conceive to ariſe from the Impulſe whereby this diurnal Motion was impreſt on the Earth, being given to the external Parts, and from thence in Time communicated to the internal; but not ſo as perfectly to equal the Velocity of the firſt Motion impreſt on, and ſtill conſerved by the ſuperficial Parts of the Globe.

As to the Quantity of this Motion, it is almoſt impoſſible to define it, both from the Nature of this Kind of Obſervation, which cannot be very accurately performed, as alſo from the ſmall Time theſe Variations have been obſerved, and their Change diſcovered. So that the nice Determination of this and of ſeveral other Particulars in the magnetic Syſtem, is reſerved for remote Poſterity; all that we can hope to do is, to leave behind us Obſervations that may be confided in, and to propoſe Hypotheſis, which after Ages may examine, amend, or refute.

Only here I muſt take Leave to recommend to all Maſters of Ships, and all others, Lovers of natural Truths, that they uſe their utmoſt Diligence to make, or procure to be made, Obſer-

32. Animals are a moſt noble Part of terreſtrial Beings, having Senſation and voluntary Motion. Of theſe ſome are aerial, or peculiar to the Air, as Birds and Flies; ſome are aquatic, or peculiar to the Waters, as Fiſhes; ſome are peculiar to the Face of the Earth, as Beaſts of four Feet, Reptiles of many Feet, and Serpents with none, and Inſects or ſmall Creatures, whoſe Bodies are almoſt ſeparated by a ſlender Ligature; and ſome are amphibious, or peculiar to both Land and Water. All of which, have in general, Senſation by ſeeing, hearing, ſmelling, taſting and feeling, much after the ſame Manner, and ſome of theſe much more acutely than Man. Theſe are ſuſtained by their Food, which, when it is chewed and broken, mixes with Saliva, and is digeſted in the Stomach, conveyed through the Guts, the Lacteals ſeparating the Chyle or nutritive Part, and con-

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ſervations of theſe Variations in all Parts of the World, as well in the North as South Latitude (after the laudable Cuſtom of our Eaſt-India Commanders) and that they pleaſe to communicate them to the Royal Society, in order to leave as compleat a Hiſtory, as may be, to thoſe that are hereafter to compare all together, and to compleat and perfect this abſtruſe Theory.

Thus, in order to explain the Change of the Variations, we have adventured to make the Earth hollow, and to place another Globe within it, and I doubt not but this will find Oppoſers enough. I know it will be objected, that there is no Inſtance in Nature of the like Thing; that if there is ſuch a middle Globe, it would not keep its Place in the Centre, but be apt to deviate therefrom, and might poſſibly chock againſt the Concave Shell to the Ruin, or at leaſt endamaging thereof; that the Water of the Sea would perpetually leak through, unleſs we ſuppoſe the Cavity full of Water; that were it poſſible, yet it does not appear of what Uſe ſuch an inward Sphere can be of, being ſhut up in eternal Darkneſs, and therefore unfit for the Production of Animals or Plants; with many more Objections, according to the Fate of all ſuch new Propoſitions.

To theſe and all other that I can foreſee, I briefly anſwer, that the Ring environing the Globe of *Saturn*, is a notable Inſtance of this Kind, as having the ſame common Centre, and moving along with the Planet, without ſenſibly approaching him on one Side more than the other. And if this Ring were turned on one of its Diameters, it would then deſcribe ſuch a Concave Sphere as I ſuppoſe our external one to be. And ſince the Ring in any Poſition given, would in the ſame Manner keep the Centre of *Saturn* in its own; it follows, that ſuch a concave Sphere may move with another included in it, having the ſame common Centre. Nor can it well be ſuppoſed otherwiſe, conſidering the Nature of Gravity; for ſhould theſe Globes be adjuſted once to the ſame common Centre, the Gravity of the Parts of the Concave, would preſs equally toward the Centre of the inner Ball, which Equality muſt neceſſarily continue till ſome external Force diſturb it.

As to the leaking of the Water through this Shell, when once a Paſſage ſhall be found for it to run thro', I muſt confeſs it an Objection ſeemingly conveying it into the Blood with which it concocts, and is forced through the Lungs, where it is enlivened by the inſpiring Air, is conveyed into the left Ventricle of the Heart, and from thence diſtributed by the Arteries to all Parts of the Body, from whence it is brought back by the returning Veins, and ſo takes the ſame Courſe.

33. The

ingly of Weight: But when we conſider how lightly great Beds of Chalk or Clay, and much more Stone do hold Water, and even Caves arched with Sand; can we then think it a hard Suppoſition, that the internal Parts of this Bubble of Earth ſhould be replete with ſuch ſaline and vitriolic Particles as may contribute to Petrifaction, and diſpoſe the tranſuding Water to ſhute and coagulate into Stone, ſo as continually to fortify, and if Need were, to conſolidate any Breach or Flaw in the concave Surface of the Shell.

And this, perhaps, may not without Reaſon be ſuppoſed to be the final Cauſe of the Admixture of the magnetical Matter in the Maſs of the terreſtrial Parts of the Globe, viz. to make good and maintain the concave Arch of this Shell. Another Argument favouring this Hypotheſis, is drawn from a Propoſition in Sir *Iſaac Newton*'s *Principia*, where he determines the Force wherewith the Moon moves the Sea in producing the Tides: His words are *Denſitas Lunæ eſt ad denſitatem Terræ ut* 680 *ad* 387 *ſeu* 9 *ad* 5 *quam proxime. Eſt igitur corpus Lunæ denſius ac magis tereſtre quam terra noſtra.*

The Denſity of the Moon is to the Denſity of the Earth, as 680 to 387, or as 9 to 5 nearly. Therefore the Body of the Moon is more denſe, and more earthy than the Earth itſelf.

Now if the Moon be more ſolid than the Earth, as 9 to 5, why may we not reaſonably ſuppoſe the Moon, being a ſmall Body and a ſecundary Planet, to be ſolid Earth, Water, Stone, and this Globe to conſiſt of the ſame Materials, only four Ninths thereof to be Cavity, within and between the internal Spheres.

And ſince it is now taken for granted, that the Earth is one of the Planets, and they all are with Reaſon ſuppoſed habitable, tho' we are not able to define by what Sort of Animals; and ſince we ſee all the Parts of the Creation abound with animate Beings, as the Air with Birds and Flies, the Water with the numerous Varieties of Fiſh, and the very Earth with Reptiles of ſo many Sorts; all whoſe Ways of living would be to us incredible, did not daily Experience teach us: Why then ſhould we think it ſtrange, that the prodigious Maſs of Matter, whereof this Globe doth conſiſt, ſhould be capable of ſome other Improvement than barely to ſerve to ſupport its Surface. But ſtill it will be ſaid, that without Light there can be no Living; and therefore, all this Apparatus of our inward Globes muſt be uſeleſs: To this I anſwer, that there are many Ways of producing Light which we are wholly ignorant of; the Medium itſelf may be always luminous, after the Manner of our Ignes fatui. The concave Arches may in ſeveral Places ſhine with ſuch a Subſtance as inveſts the Face of the Sun; nor can we, without a Boldneſs, unbecoming a Philoſopher, adventure to aſſert the Impoſſibility of peculiar Luminaries below, of which we have no Sort of Idea.

Thus far from Dr. *Halley*, and which we have tranſcribed as a Memento or Remembrancer to ſuch of our Readers, as ſhall in after Times be furniſhed with more ample Obſervations for ſettling the Courſe and Period of the magnetic Syſtem.

33. The Underſtanding is the moſt diſtinguiſhing Characteriſtic of the human Species, and is peculiar only to the Mind. For although we can perceive Bodies by our Senſes, * retain full and clear Ideas of them, and compare or compound thoſe Ideas, yet we could not know their Reſult without this Underſtanding in our Minds. The Manner in which we come to un-

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* The immortal Sir *Iſaac Newton*, having given us, in his Optics, a moſt conciſe yet ſublime Deſcription of the Phenomena of Nature, worthy the Attention of the moſt Knowing, and particularly ſuch as would acquire a certain Knowledge in philoſophical Matters; we beg Leave to introduce an Extract thereof as follows:

If (ſaith he) in two large tall cylindrical Veſſels of Glaſs inverted, two little Thermometers be ſuſpended ſo as not to touch the Veſſels, and the Air being drawn out of one of theſe Veſſels, and theſe Veſſels thus prepared be carried out of a cold Place into a warm one; the Thermometer in Vacuo will grow warm as much, and almoſt as ſoon as the Thermometer which is not in Vacuo. And when the Veſſels are carried back into the cold Place, the Thermometer in Vacuo will grow cold almoſt as ſoon as the other Thermometer.

Is not the Heat of the warm Room conveyed through the Vacuum by the Vibrations of a much ſubtiler Medium than Air, which after the Air was drawn out remained in the Vacuum? And is not this Medium the ſame with that Medium by which Light is refracted and reflected, and by whoſe Vibrations Light communicates Heat to Bodies, and is put into Fits of eaſy Reflection and eaſy Tranſmiſſion? And do not the Vibrations of this Medium, in hot Bodies, contribute to the Intenſeneſs and Duration of their Heat? And do not hot Bodies communicate their Heat to contiguous cold Ones, by the Vibrations of this Medium propagated from them into the cold Ones? And is not this Medium exceedingly more rare and ſubtile, than Air, and exceedingly more elaſtic and active? And doth it not readily pervade all Bodies? And is it not by its elastic Force expanded thro' all the Heavens?

Doth not the Refraction of Light proceed from the different Denſity of this ætherial Medium in different Places, the Light receding always from the denſer Parts of the Medium? And is not the Denſity thereof greater in free and open Spaces, void of Air, and other groſſer Bodies, than within the Pores of Water, Glaſs, Cryſtal, Gems, and other compact Bodies? For when Light paſſes through Glaſs or Cryſtal, and falling very obliquely upon the farther Surface thereof, is totally reflected, the total Reflection ought to proceed rather from the Denſity and Vigour of the Medium without, and beyond the Glaſs, than from the Rarity and Weakneſs thereof.

Doth not this ætherial Medium, in paſſing out of Water, Glaſs, Cryſtal, and other compact and denſe Bodies into empty Spaces, grow denſer and denſer by Degrees, and by that Means refract the Rays of Light, not in a Point, but by bending them gradually in Curve-lines? And doth not the gradual Condenſation of this Medium extend to ſome Diſtance from the Bodies, and thereby cauſe the Inflections of the Rays of Light, which paſs by the Edges of denſe Bodies, at ſome Diſtance from the Bodies?

Is not this Medium much rarer within the denſe Bodies of the Sun, Stars, Planets and Comets, than in the empty celeſtial Spaces between them? And in paſſing from them to greater Diſtances, doth it not grow denſer and denunderſtand, is by our Senſes. For Seeing the Eye is an Organ, wonderfully adapted with its Coats and Humours, beſides which a luminous Body, emitting indefinitely ſmall Particles or Rays; Air or Æther to turn theſe Particles out of a ſtraight Courſe; and Bodies or Objects themſelves not pellucid, are all neceſſary to the Completion of Viſion. Such Rays coming from the Sun and

denſer perpetually, and thereby cauſe the Gravity of thoſe great Bodies toward one another, and of their Parts toward the Bodies? Every Body endeavouring to go from the denſer Parts of the Medium toward the Rarer? For if this Medium be rarer within the Sun's Body than at this Surface, and rarer there than at the hundredth Part of an Inch from his Body, and rarer there than at the fiftieth Part of an Inch from his Body, and rarer there than at the Orb of *Saturn*; I ſee no Reaſon why the Increaſe of Denſity ſhould ſtop any where, and not rather be continued through all Diſtances from the Sun to *Saturn* and beyond. And though this Increaſe of Denſity may at great Diſtances be exceedingly ſlow, yet if the elaſtic Force of this Medium be exceedingly great, it may ſuffice to impel Bodies, from the denſer Parts of the Medium towards the Rarer, with all that Power which we call Gravity.

And that the elaſtic Force of this Medium is exceeding great, may be gathered from the Swiftneſs of its Vibrations. Sounds move about 1140 *Engliſh* Feet in a Second of Time, and in ſeven or eight Minutes of Time they move about One Hundred *Engliſh* Miles. Light moves from the Sun to us in about ſeven or eight Minutes of Time, which Diſtance is about 70,000000 *Engliſh* Miles, ſuppoſing the horizontal Parallax of the Sun to be about 12 Seconds. And the Vibrations of Pulſes of this Medium, that they may cauſe the alternate Fits of eaſy Tranſmition and eaſy Reflection, muſt be ſwifter than Light, and by Conſequence, above 700,000 Times ſwifter than Sounds. And therefore, the elaſtic Force of this Medium in Proportion to its Deſity is 700,000 x 700,000 (viz. above 490,000,000000) Times greater than the elaſtic Force of the Air is in Proportion to its Denſity. For the Velocities of the Pulſes of elaſtic Mediums, are in a ſubduplicate Ratio of the Elaſticities, and the Rarities of the Mediums taken together.

As Attraction is ſtronger in all ſmall Magnets than in great Ones in Proportion to their Bulk, and Gravity is greater in the Surfaces of ſmall Planets than in thoſe of great Ones in Proportion to their Bulk, and ſmall Bodies are agitated much more by electric Attraction than great Ones; ſo the Smallneſs of the Rays of Light may contribute very much to the Power of the Agent by which they are refracted. And ſo if any one ſhould ſuppoſe that Æther (like our Air) may contain Particles which endeavour to recede from one another (for I do not know what this Æther is) and that its Particles are exceedingly ſmaller than thoſe of Air, or even than thoſe of Light: The exceeding Smallneſs of its Particles, may contribute to the Greatneſs of the Force by which thoſe Particles may recede from one another, and thereby make that Medium exceedingly more rare and elaſtic than Air, and by Conſequence leſs able to reſiſt the Motions of Projectiles, and exceedingly more able to preſs upon groſs Bodies, by endeavouring to expand itſelf.

May not Planets and Comets, and all groſs Bodies, perform their Motions more freely and with leſs Reſiſtance in this ætherial Medium, than in and Stars, a Candle or other luminous Subſtance, with a very great Degree of Swiftneſs, paſs to the Retina or Bottom of the Eye, where they paint the Images of the Objects againſt which they have laſt impinged, and this immediately excites Viſion. For Hearing the Ear is an Organ, which receives the Vibrations of the Air occaſioned by a quick and tremulous Motion of the ſo-

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in any Fluid which fills all Space adequately without leaving any Pores, and by Conſequence is much denſer than Quickſilver or Gold? And may not its Reſiſtance be ſo ſmall as to be inconſiderable? For Inſtance; if this Æther (for ſo I will call it) ſhould be ſuppoſed 700,000 Times more elaſtic than our Air, and above 700,000 Times more rare, its Reſiſtance would be above 600,000000 Times leſs than that of Water. And ſo ſmall a Reſiſtance would ſcarce make any ſenſible Alteration in the Motions of the Planets in 10,000 Years.

If any one would aſk how a Medium could be ſo rare, let him tell me how the Air in the upper Part of the Atmoſphere can be above a hundred thouſand Times rarer than Gold. Let him alſo tell me how an electric Body, can by Friction emit an Exhalation ſo rare and ſubtile, and yet ſo potent, as by its Emiſſion, to cauſe no ſenſible Diminution of the Weight of the electric Body, and to be expanded thro' a Sphere, whoſe Diameter is above two Feet, and yet to be able to agitate and carry up Leaf-copper, or Leaf-gold, at the Diſtance of above a Foot from the electric Body. And how the Effluvia of a Magnet can be ſo rare and ſubtile as to paſs through a Plate of Glaſs without any Reſiſtance or Diminution of their Force, and yet ſo potent as to turn a magnetic Needle beyond the Glaſs?

Is not Viſion performed chiefly by the Vibrations of this Medium excited in the Bottom of the Eye, by the Rays of Light, and propagated through the ſolid, pellucid and uniform Capillamenta of the optic Nerves, into the Place of Senſation? And is not Hearing performed by the Vibrations, either of this or ſome other Medium, excited in the auditory Nerves by the Tremours of the Air, and propagated through the ſolid, pellucid and uniform Capillamenta of thoſe Nerves into the Place of Senſation? And ſo of the other Senſes.

Is not animal Motion performed by the Vibrations of this Medium, excited in the Brain by the Power of the Will, and propagated from thence thro' the ſolid, pellucid and uniform Capillamenta of the Nerves into the Muſcles for contracting and dilating them? I ſuppoſe that the Capillamenta of the Nerves are each of them ſolid and uniform, that the vibrating Motion of the ætherial Medium may be propagated along them, from one End to the other uniformly, and without Interruption: For Obſtructions in the Nerves create Palſies. And that they may be ſufficiently uniform, I ſuppoſe them pellucid when viewed ſingly, though the Reflections in their cylindrical Surfaces, may make the whole Nerve (compoſed of many Capillamenta) appear opake and white. For Opacity ariſes from reflecting Surfaces, ſuch as may diſturb and interrupt the Motions of this Medium.

Do not all fixed Bodies, when heated beyond a certain Degree, emit Light and ſhine? And is not this Emiſſion performed by the vibrating Motion of their Parts? And do not all Bodies which abound with terreſtrial Parts, and eſpecially with ſulphurous Ones, emit Light as often as thoſe Parts are ſufficiently agitated, whether that Agitation be made by Heat, or by Friction or Percuſſion, or Putrefaction, or by any vital Motion, or

any

ſonorous Body, on a ſudden Stroke or Shock. For Smelling, the olfactory Nerves, receiving odoriferous Particles, excite this Senſation. For Taſting, the Palate is an Organ, which, receiving the Contact of ſweet, bitter, ſower, and other Subſtances, excites this Senſation. For Touch or Feeling, the whole nervous Syſtem, diffuſed unequally through the Body, and

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any other Cauſe? As for Inſtance, Sea-water in a raging Storm; Quickſilver agitated in Vacuo; the Back of a Cat or Neck of a Horſe, obliquely ſtruck or rubbed in a dark Place; Wood, Fleſh and Fiſh, while they Putrify; Vapours ariſing from putrified Water, uſually called Ignes Fatui; Stacks of moiſt Hay, or Corn growing hot by Fermentation; Glowworms, and the Eyes of ſome Animals by vital Motions; the vulgar Phoſphorus agitated by the Attrition of any Body, or by the acid Particles of the Air; Amber, and ſome Diamonds, by ſtriking, preſſing, or rubbing them; ſcrapings of Steel, ſtruck off with a Flint; Iron hammered very nimbly, till it becomes ſo hot as to kindle Sulphur thrown upon it; the Axle-trees of Chariots taking Fire by the rapid Rotation of the Wheels; and ſome Liquors mixed with one another, whoſe Parcles come together with an Impetus, as Oil of Vitriol diſtilled from its Weight of Nitre, and then mixed with twice its Weight of Oil of Aniſeeds.

Is not Fire a Body heated ſo hot as to emit Light copiouſly? For what elſe is a red hot Iron than Fire? And what elſe is a burning Coal than red hot Wood? Is not Flame a Vapour, Fume, or Exhalation heated red hot, that is, ſo hot as to ſhine? For Bodies do not Flame without emitting a copious Fume, and this Fume burns in the Flame. The Ignis Fatuus is a Vapour ſhining without Heat, and is there not the ſame Difference between this Vapour and Flame, as between rotten Wood ſhining without Heat and burning Coals of Fire?

Do not great Bodies conſerve their Heat the longeſt, their Parts heating one another, and may not great denſe and fixed Bodies, when heated beyond a certain Degree, emit Light ſo copiouſly, as by the Emiſſion and Reaction of its Light, and the Reflections and Refractions of its Rays within its Pores to grow ſtill hotter, till it comes to a certain period of Heat, ſuch as is that of the Sun? And are not the Sun and fixed Stars great Earths vehemently hot, whoſe Heat is conſerved by the Greatneſs of the Bodies, and the mutual Action and Reaction between them and the Light which they emit, and whoſe Parts are kept from fuming away, not only by their Fixity, but alſo by the vaſt Weight and Denſities of the Atmoſpheres incumbent upon them; and very ſtrongly compreſſing them, and condenſing the Vapours and Exhalations which ariſe from them? For if Water be made warm in any pellucid Veſſel emptied of Air, that Water in the Vacuum will bubble and boil as vehemently as it would in the open Air in a Veſſel ſet upon the Fire, till it conceives a much greater Heat. For the Weight of the incumbent Atmoſphere keeps down the Vapours and hinders the Water from boiling until it grow much hotter than is requiſite to make it boil in Vacuo. Alſo a Mixture of Tin and Lead being put upon a red hot Iron in Vacuo emits a Fume and Flame; but the ſame Mixture in the open Air, by reaſon of the incumbent Atmoſphere, does not ſo much as emit any Fume which can be perceived by Sight.

In like Manner, the great Weight of the Atmoſphere which lies upon the Globe of the Sun, may hinder Bodies there from riſing up and going away and moſt powerfully at the Finger's Ends may be taken for one continued Organ, and in contact with hard, ſoft, ſmooth, rough, dry, wet, hot and cold Bodies excites this Senſation. From which it may be obſerved, that all Senſations are but different Modifications of Feeling, or the Contact of Bodies on ſome particular Part of the human Frame. By theſe Senſations,

away from the Sun in the Form of Vapours and Fumes; unleſs by Means of a far greater Heat than that which on the Surface of our Earth would very eaſily turn them into Vapours and Fumes. And the ſame great Weight may condenſe thoſe Vapours and Exhalations as ſoon as they ſhall at any Time begin to aſcend from the Sun, and make them preſently fall back again into him, and by that Action increaſe his Heat much after the Manner that in our Earth the Air increaſes the Heat of a culinary Fire. And the ſame Weight may hinder the Globe of the Sun from being diminiſhed, unleſs by the Emiſſion of Light, and a very ſmall Quantity of Vapours and Exhalations.

Do not the Rays of Light, in falling upon the Bottom of the Eye, excite Vibrations in the Tunica Retina? Which Vibrations being propagated along the ſolid Fibres of the optic Nerves into the Brain, cauſe the Senſe of Seeing. For becauſe denſe Bodies conſerve their Heat a long Time, and the denſeſt Bodies conſerve their Heat the longeſt, the Vibrations of their Parts are of a laſting Nature, and therefore may be propagated along ſolid Fibres of uniform denſe Matter to a great Diſtance, for conveying into the Brain the Impreſſions made upon all the Organs of Senſe. For that Motion which can continue long in one and the ſame Part of a Body, can be propagated a long Way from one Part to another, ſuppoſing the Body homogeneal, ſo that the Motion may not be reflected, refracted, interrupted or diſordered by any Unevenneſs of the Body.

Do not ſeveral Sorts of Rays make Vibrations of ſeveral Bigneſſes, which according to their Bigneſſes excite Senſations of ſeveral Colours, much after the Manner, that the Vibrations of the Air, according to their ſeveral Bigneſſes, excite Senſations of ſeveral Sounds? And particularly do not the moſt refrangible Rays excite the ſhorteſt Vibrations for making a Senſation of deep Violet, the leaſt refrangible, the largeſt for making a Senſation of deep Red, and the ſeveral intermediate Sorts of Rays, Vibrations of ſeveral intermediate Bigneſſes to make Senſations of the ſeveral intermediate Colours?

May not the Harmony and Diſcord of Colours, ariſe from the Proportions of the Vibrations propagated through the Fibres of the optic Nerves into the Brain, as the Harmony and Diſcord of Sounds ariſe from the Proportions of the Vibrations of the Air? For ſome Colours, if they be viewed together, are agreeable to one another, as thoſe of Gold and Indigo, and others diſagree.

Are not groſs Bodies, and Light convertible into one another, and may not Bodies receive much of their Activity from the Particles of Light which enter their Compoſition? For all fixed Bodies being heated, emit Light ſo long as they continue ſufficiently hot, and Light mutually ſtops in Bodies as often as its Rays ſtrike upon the Parts. I know no Body leſs apt to ſhine than Water; and yet Water by frequent Diſtillations changes into fixed Earth, as Mr. *Boyle* has tried; and then this Earth being enabled to endure a ſufficient Heat, ſhines by Heat like other Bodies.

The changing of Bodies into Light, and Light into Bodies, is very conformtions, we have ſtrong Impreſſions on our Minds, called ſimple Ideas, which we are able to compare and compoſe, making of them complex Ones. From theſe we are able to draw abſtract Ideas, leſs dependant on Bodies, and by Concatenation and Ratiocination deduce complex Truths.

34. The

formable to the Courſe of Nature, which ſeems delighted with Tranſmutations. Water which is a very fluid taſteleſs Salt, ſhe changes by Heat into Vapour, which is a Sort of Air, and by Cold into Ice, which is a hard, pellucid, brittle, fuſible Stone; and this Stone returns into Water by Heat, and Vapour returns into Water by Cold. Earth by Heat becomes Fire, and by Cold returns into Earth. Denſe Bodies by Fermentation rarify into ſeveral Sorts of Air, and this Air by Fermentation, and ſometimes without it returns into denſe Bodies. Mercury ſometimes appears in the Form of a fluid Metal, ſometimes in the Form of a hard, brittle Metal, ſometimes in the Form of a corroſive, pellucid Salt, called ſublimate, ſometimes in the Form of a taſteleſs, pellucid, volatile, white Earth, called Mercurius Dulcis; or in that of a red, opake, volatile Earth, called Cinnabar; or in that of a red or white Precipitate; or in that of a fluid Salt; and in Diſtillation it turns into Vapour, and being agitated in Vacuo, it ſhines like Fire. And after all theſe Changes, it returns into its firſt Form of Mercury. Eggs grow from inſenſible Magnitudes, and change into Animals; Tadpoles, into Frogs; and Worms, into Flies. All Birds, Beaſts and Fiſhes, Inſects, Trees and other Vegetables, with their ſeveral Parts, grow out of Water and watry Tinctures and Salts, and by Putrefaction return again into watry Subſtances. And Water ſtanding a few Days in the open Air, yields a Tincture, which (like that of Malt) by ſtanding longer yields a Sediment and a Spirit, but before Putrifaction is fit Nouriſhment for Animals and Vegetables. And among ſuch various and ſtrange Mutations, why may not Nature change Bodies into Light, and Light into Bodies?

Have not the ſmall Particles of Bodies certain Powers, Vertues or Forces, by which they act at a Diſtance, not only upon the Rays of Light for reflecting, refracting and inflecting them, but alſo upon one another for producing a great Part of the Phenomena of Nature? For it's well known, that they act one upon another by the Attractions of Gravity, Magnetiſm and Electricity; and theſe Inſtances ſhew the Tenure and Courſe of Nature, and make it not improbable that there may be more attractive Powers than theſe. For Nature is very conſonant and conformable to herſelf. How theſe Attractions may be performed, I do not here conſider. What I call Attraction, may be performed by Impulſe, or by ſome other Means unknown to me. I uſe that Word here to ſignify only in general any Force by which Bodies tend towards one another, whatſoever be the Cauſe.

By Experiments compared with the great Quantity of Sulphur with which the Earth abounds, and the Warmth of the interior Parts of the Earth, and hot Springs and burning Mountains, and with Damps, mineral Coruſcations, Earthquakes, hot ſuffocating Exhalations, Hurricanes and Spouts; we may learn, that ſulphureous Steams abound in the Bowels of the Earth and ferment with Minerals, and ſometimes take Fire with a ſudden Coruſcation and Exploſion; and if pent up in ſubterraneous Caverns, burſt the Caverns with a great ſhaking of the

Earth,

34. The Moon is the Second great Luminary of the Heavens. She is the neareſt Planet to our Earth, and much leſs than either of the primary Planets, moves round the Earth between the Orbits of *Venus* and *Mars*, is diſturbed in her Motion, together with the Earth, by the Attractions of the other Planets, and particularly *Venus*, which is large and ſometimes very near. Theſe Diſturbances render her true Place and that of the Earth uncertain to a great Degree of Exactneſs, and the Computation of the ſame for any paſt, preſent, or future Time, is a Taſk with the great-

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Earth, as in ſpringing a Mine, and then the Vapour, generated by the Exploſion, expiring through the Pores of the Earth, feels hot and ſuffocates, and makes Tempeſts and Hurricanes, and ſometimes cauſes the Land to ſlide, or the Sea to boil, and carries up the Water thereof in Drops, which by their Weight fall down again in Spouts. Alſo ſome ſulphureous Steams, at all Times when the Earth is dry, aſcending into the Air, ferment there with nitrous Acids, and ſometimes taking Fire, cauſe Lightning and Thunder and fiery Meteors. For the Air abounds with acid Vapours, fit to promote Fermentations, as appears by the ruſting of Iron and Copper in it, the kindling of Fire by blowing, and the beating of the Heart by means of Reſpiration. Now the abovementioned Motions are ſo great and violent, as to ſhew that in Fermentations the Particles of Bodies which almoſt reſt, are put into new Motions by a very potent Principle, which acts upon them only when they approach one another, and cauſes them to meet and claſh with great Violence, and grow hot with the Motion, and daſh one another into Pieces, and vaniſh into Air, Vapours and Flames.

As Gravity makes the Sea flow round the denſer and weightier Parts of the Globe of the Earth, ſo the Attraction may make the watry Acid flow round the denſer and compacter Particles of the Earth for compoſing the Particles of the Salt. For otherwiſe the Acid would not do the Office of a Medium between the Earth and common Water, for making Salts diſſolvable in the Water; nor would Salt of Tartar readily draw off the Acid from diſſolved Metals, nor Metals the Acid from Mercury. Now, as in the great Globe of the Earth and Sea, the denſeſt Bodies by their Gravity ſink down in Water, and always endeavour to go towards the Centre of the Globe; ſo in Particles of Salt, the denſeſt Matter may always endeavour to approach the Centre of the Particle: So that a Particle of Salt may be compared to a Chaos, being denſe, hard, dry and earthy in the Centre; and rare, ſoft, moiſt and watry in the Circumference. And hence it ſeems to be, that Salts are of a laſting Nature, being ſcarce deſtroyed, unleſs by drawing away their watry Parts by Violence, or by letting them ſoak into the Pores of the central Earth, by a gentle Heat in Putrefaction, until the Earth be diſſolved by the Water, and ſeparated into ſmaller Particles, which by Reaſon of their Smallneſs, make the rotten Compound appear of a black Colour. Hence alſo it may be, that the Parts of Animals and Vegetables preſerve their ſeveral Forms, and aſſimilate their Nouriſhment, the ſoft and moiſt Nouriſhment eaſily changing its Texture by a gentle Heat and Motion, till it becomes like the denſe, hard, dry and durable Earth in the Centre of each Particle. But when the Nouriſhment grows unfit to be aſſimilated, or the central Earth grows too feeble to aſſimilate it, the Motion ends in Confuſion, Putrefaction and Death.

greateſt Mathematicians of the preſent Age, next to inſuperable. Could this be made eaſily practicable, the geographical Situation of Places on the Earth's Globe, and the Art of Navigation would be more certain. She is an opake Body, having her Light from the Sun, but continually preſents the ſame Face toward our Earth, turns round her own Axis exactly in the ſame Time in which ſhe makes a Revolution round her Orbit, from which it has been thought that ſhe abounds with magnetical Matter like our Earth, and that her Poſition is directed thereby. One half of her Surface is illuminated by the Sun, the other half is dark. That Side facing our Earth, hath abundance of Irregularities and Protuberances with Light and dark Spots, which have been taken for Mountains, woody or ruſhy Plains, Lakes and Seas of great Amplitude and Extent, alſo round Cavities, dark at Bottom, many Leagues wide, of great Depth, with conical Mounts in the Midſt which have been taken for deep Pits, ſome dry and others partly filled with Water. This Planet is very irregular in her apparent Motion, receding 360 Degrees, and traverſing through all the Signs, with wide Excurſions from North or South in about 27 ¼ Days, in which Time ſhe finiſhes a Revolution round the Earth, her Orbit being inclined to that of the Earth, under an Angle of 5 ¼ Degrees, and the Time of her coming to the South, about 53 Minutes later every Day than the preceding one. She appears largeſt when riſing or ſetting (as doth the Sun) but meaſures leſs in Diameter then, than when ſhe is in the Zenith; the Cauſe of this is the Nature and Properties of Viſion. At the autumnal Equinox ſhe riſes about the ſame Hour for ſeveral Days together, which is occaſioned by the Poſition of her Orbit, the Poſition of the Earth's Orbit, and the Poſition of the Horizon at that Time, and as this is about the Time of Harveſt, ſhe is then called the Harveſt or Hunter's Moon. She caſts a very long conical Shadow, which falls on the Earth, when ſhe is between the Sun and Earth, this makes an Eclipſe of the Sun, the Earth alſo caſts a much larger conical Shadow, which, when it is between the Moon and Sun, falls on the Moon and makes an Eclipſe of that Luminary. The Moon appears to have neither Clouds nor Vapours, and therefore is thought to have no Atmoſphere, or, if any, but a very thin one, nor is it known whether ſhe is inhabited, although generally ſuppoſed to be ſo, like our Earth. Other Particulars relating to this Planet, may be ſeen in the following Tables.

35. **Mars** is the fourth Planet in the ſolar Syſtem, and moves round the Sun between the Orbits of the *Earth* and *Jupiter*. He is much leſs, and alſo leſs denſe than our Earth, to which he comes very near in Perigeon, and therefore ſometimes appears large, red and fiery, and at other Times very ſmall. He has an Atmoſphere with a large dark Spot in the Middle of his Face, and other Irregularities, which probably are Seas and inhabited Lands. Other Particulars relating to this Planet, may be ſeen in the following Tables.

36. **Jupiter** is the fifth, and by far the largeſt Planet in the ſolar Syſtem, he moves round the Sun, between the Orbits of *Mars* and *Saturn*, and has but a twenty-ſeventh Part of the Heat from the Sun that we have. He has a rough Face with dark Spots, and three duſkiſh Belts, or Girdles, croſſing his Body, all which are ſubject to ſmall Changes and Alterations, and are therefore thought to be Clouds and Vapours ſwiming in his Atmoſphere ; if ſo, this Planet muſt enjoy great Serenity of Weather, but if they adhere to his Body, great Diſorder and Confuſion of Lands and Waters, he having all the other Properties of a habitable World. Four Moons, or **Satellites**, are continually moving round this Planet, as the Moon moves round our Earth, all of which are within *Jupiter*'s Blaze and inviſible to the naked Eye, but are ſeen through a Teleſcope, in a right Line with each other and *Jupiter*, except when they are hid behind his Body, in his Shadow, or in his Rays, which latter Place renders them obſcure. The Immerſions and Emerſions of theſe Satellites furniſh frequent Opportunities for taking the Longitudes of Places at Land wherever the Eclipſes can be obſerved, the Immerſions being always to be obſerved when *Jupiter* is more Weſt, and the Emerſions when he is more Eaſt than the Sun, and theſe would anſwer the ſame End at Sea, and make the Art of Navigation perfect, could good Teleſcopes be uſed ſo as to keep the Planet and Satellites in View on the Ocean. Other Particulars relating to this Planet, may be ſeen in the following Tables.

37. **Saturn** is the ſixth and higheſt primary Planet in the ſolar Syſtem. He is much larger than either of the Planets except *Jupiter*, and moves round the Sun in an Orbit of vaſt Extent, between the Orbit of *Jupiter* below, and the fixed Stars, which are at an immenſe Diſtance beyond him. He is leſs denſe than our Earth, and has but little more than a hundredth Part of the Heat and Light that we enjoy, and therefore his polar

Regions muſt be as many Times intenſly cold as at the Poles of the Earth's Globe. He appears ſmall, whitiſh and dull, with an irregular Surface like the other Planets, and probably hath Inhabitants. This Planet has a large and wonderful Ring of ſolid Matter encompaſſing his Body, without any where touching it, of which extraordinary Phænomenon various Conjectures have been made, but nothing certain is yet known. Five SATELLITES, or Moons, alſo continually move round his Body, like the Satellites of *Jupiter* round *Jupiter*'s Body, the Immerſions of which can only be ſeen when he is Weſt before the Sun, and the Emerſions when he is Eaſt after the Sun. Their Uſes being the ſame with thoſe of *Jupiter*, but not ſo viſible. Other Particulars relating to this Planet, may be ſeen in the following Tables.

38. COMETS, or Blazing-ſtars, are wandering Planets, which move round the Sun, in elliptical Orbits which are very eccentric, and in their Motions they are regulated by the ſame Laws as the other Planets. Theſe Bodies are very numerous, their Orbits variouſly inclined, and it is quite uncertain when they will appear, their true Theory being but of late diſcovered, and their periodic Revolutions not yet obſerved, beſide which they are accelerated and retarded in their Motions by the Actions of the other Planets, which will always make the Time of their Return very uncertain. They are opake Bodies, having their Light from the Sun, appear under different Forms and different Colours, generally with a long fiery Tail or Blaze, which makes a very frightful Appearance in the Heavens, in a dark Night when the Sky is clear. Some of them croſs the Orbits of the Planets, deſcend to their Perihelia nearer the Sun than *Mercury*, and are there above 2000 Times hotter than red-hot Iron, from thence aſcend to their Aphelia, immenſly far beyond the Regions of *Saturn*, and are there moſt intenſly cold. Their Tails are produced of the inflameable Matter of their Bodies and Atmoſpheres, which flies off in fiery Vapours by the Action of the ſolar Rays, and is ſo exceedingly rarified as to be able to produce no bad Conſequences on our Earth, ſhould it ever happen to be invelloped therein at a conſiderable Diſtance; which poſſibly may be, for theſe Bodies, croſſing the ſolar Syſtem in all Directions, may ſtrike againſt the Planets, and therefore our Earth, the Effects of which might be the uniting of the Bodies and their Centres of Gravity into one, the Removal of the Oceans to other Parts of the Earth's Globe, and great Devaſtation

ſtation within, and on the Surface of our Globe. Otherwiſe, the centripetal Force of each Body, or a repulſive Power in both, may conſtruct a new Orbit for each, and the ſcattered Fragments be carried away with them. Such a Salute we hope will never happen to our Earth. The Origin and Uſe of theſe Bodies is not known, but they are thought to fall freely into the Sun, after making a great Number of irregular Gyrations round his Body, and that they are conſtant Supplies to him of freſh Fuel for maintaining his Blaze. Other Particulars relating to Comets, may be ſeen in the following Tables.

39. The FIXED STARS, are thoſe apparently ſmall, lucid, twinkling Lights, which bedeck the Heavens when the Moon doth not ſhine, and the Sky is clear. They appear to riſe and ſet, or move round the Axis of our Earth in twenty-four Hours from Eaſt to Weſt, like the Sun and Planets, which is occaſioned by the Earth's Rotation from Weſt to Eaſt, and are ſaid to be fixed, becauſe they continually keep the ſame Poſition among themſelves. The more viſible Ones are but few, thoſe inviſible to the naked Eye are innumerable, when looked at through good Teleſcopes. They all ſhine with a native Luſtre, have no dependance on our Sun or any Part of the ſolar Syſtem, appear like lucid Points through the beſt Teleſcopes, and probably are ſo many Suns, each having his Planets and Comets like ours. The Diſtance of theſe Stars is at leaſt 40,000 Times greater than the Diſtance of the Sun from us; the Time which the Rays of Light take in coming from them to us is ſix Years, at the Rate of 10,000000 Miles per Minute, and their Diſtance from the Sun ſo great, that at either of them he appears but a lucid Point, as they do to us, and Ninety-nine hundredths of the intermediate Diſtance is dark Night. Many bright Places are alſo obſerved in the Heavens, which, when viewed through good Teleſcopes, appear to be innumerable Multitudes of ſmall Stars, of which the milky Way is one continued Band or Girdle paſſing quite round the Heavens. All the fixed Stars have an apparent Motion in a Direction parallel with the Ecliptic, at the Rate of about 50 Seconds of a Degree per Annum, by which they are continually altering their Longitudes, right Aſcenſions and Declinations, but their Latitudes remain invariable, or nearly ſo; beſides this, they appear to deſcribe a ſmall Ellipſis round their true Places in the Heavens, which is occaſioned by the Abberation of Light, or its coming from thoſe Stars to us.

TABLES of the SOLAR SYSTEM.

40. *A* TABLE, *ſhewing the greateſt, mean, and leaſt Diſtances of the primary Planets from the Sun, with their Eccentricities in Miles.*

	Greateſt Diſtance. Mill. Thouſ.	Mean Diſtance. Miles.	Leaſt Diſtance. Miles.	Eccentricity. Miles.
Mercury	37.752.480	31.445.100	24.857.280	6.455.700
Venus	58.960.710	58.590.000	58.094.010	427.770
Earth	82.402.920	81.000.000	79.597.080	1.370.520
Mars	134.771.850	123.418.890	111.941.190	11.421.000
Jupiter	441.458.910	421.289.100	400.890.060	20.290.500
Saturn	816.757.020	772.578.000	729.254.360	44.307.000

The like for the Moon from our Earth.

Moon	258.131	240.675	223.734	17.016

41. *A* TABLE, *ſhewing the Diameters of the Sun and Planets in Miles, and alſo the Surface, Magnitude and Quantity of Matter in each, the Surface and Magnitude of our Earth being* 1, *or Unity.*

	Diameters.	Surfaces.	Magnitud.	Quant. Matt.
Sun	763.460 Miles	9.241	888.300	200.000
Mercury	2.460	$\frac{1}{10}$	$\frac{1}{33}$	$\frac{1}{30}$
Venus	7.906	nearly 1	nearly 1	$\frac{4}{5}$
Earth	7.942	1	1	1
Mars	4.444	$\frac{1}{3}$	$\frac{1}{6}$	$\frac{1}{13}$
Jupiter	81.155	104	1066	214
Saturn	67.870	73	624	76
Moon	2.175	$\frac{1}{13}$	$\frac{1}{50}$	$\frac{1}{40}$

42. *A* TABLE, *ſhewing how many Miles the Planets move in their Orbits, per Day, Hour and Minute, at a Mean.*

	Per Day.	Per Hour.	Per Minute.
Mercury	2.181.818	90.909	1.515
Venus	1.576.837	65.701	1.095
Earth	1.395.307	58.138	985
Mars	1.074.235	44.759	746
Jupiter	587.189	24.466	407
Saturn	433.301	18.054	301
Moon	52833	2.201	36

43. *A* TABLE, *ſhewing the Planets daily mean Motions, with the Number of Miles they are drawn from their Rectilinear Directions per Hour, their Denſities, Light and Heat, compared with our Earth.*

	Daily Motions.	Hourly Grav.	Denſities.	Light & Heat.
Sun	at reſt.	at reſt.	$\frac{1}{4}$	45.000
Mercury	4° 5′ 32″	129 Miles	$1\frac{1}{10}$	7
Venus	1 36 8	$36\frac{1}{2}$	$\frac{4}{5}$	2
Earth	0 59 8	25	1	1
Mars	0 31 57	8	$\frac{7}{10}$	$\frac{4}{10}$
Jupiter	0 4 59	$\frac{71}{100}$	$\frac{1}{4}$	$\frac{1}{27}$
Saturn	0 2 0	$\frac{21}{100}$	$\frac{1}{6}$	$\frac{1}{90}$
Moon	13 9 24	10	$1\frac{1}{4}$	1

44. *A* TABLE, *ſhewing the Times in which the Planets move round the Sun, and alſo round their own Axis.*

	Rotations round their own Axes.			Revolutions round the Sun.		
	Days.	Hrs.	Min.			
Sun	25	5	0	at reſt.		
				Days.	Hrs.	Min.
Mercury	0	6	0	87	23	16
Venus	0	23	0	224	16	49
Earth	0	23	56	365	5	49
Mars	1	0	40	686	23	27
Jupiter	0	9	56	4332	12	20
Saturn	29	10	1	10759	6	36
Moon	27	7	45	27 round the Earth.	7	45

45. *A* TABLE *of the Inclination of the Planets Orbits, to the Plane of the Ecliptic, and the Inclination of their Axis to their own Orbits.*

	Inc. to Ecliptic.		Axes Inc. to their own Orbits.
	°	′	
Sun	87	30	At reſt.
Mercury	6	54	Not known.
Venus	3	24	Not known.
Earth	coincident		66° 30′
Mars	1	52	Perp. nearly.
Jupiter	1	20	Perp. nearly.
Saturn	2	30	31° 00′
Moon.	5	18	Right Ang. nearly.

46. *A* TABLE *of the Sun and Planets greateſt and leaſt apparent Diameters, as viewed from the Earth.*

	Diamet. in Perigeon.			Diamet. in Apogeon.		
Sun	32′	47″	0‴	31′	40″	0‴
Mercury	0	11	48	0	4	4
Venus	1	5	58	0	9	34
Mars	0	20	50	0	2	46
Jupiter	0	24	12	0	14	36
Saturn	0	19	40	0	14	11
Moon	29	24	0	33	40	0

47. *A* TABLE, *ſhewing the Places of the Planets Nodes and Apheliums.*

	Nodes.				Apheliums.			
Mercury	♉	15°	1′	54″	♐	13°	7′	54″
Venus	♊	14	25	54	♒	4	19	54
Earth	None.				♑	8	1	10
Mars	♉	18	29	54	♍	0	31	54
Jupiter	♋	7	19	54	♎	9	9	54
Saturn	♋	21	49	54	♐	27	49	54

48. *A* TABLE, *ſhewing the mean Diſtances of* Jupiter's *Satellites from his Centre, in Diameters of his Body, and the Times of their Revolutions round him.*

Satellites.	Diſtances.	Revolutions.				Magnit.
		Days.	Hrs.	′	″	
Firſt	$2\frac{5}{6}$	1	18	27	34	2
Second	$4\frac{1}{2}$	3	13	13	42	3
Third	$7\frac{1}{6}$	7	3	42	36	1
Fourth	$12\frac{2}{3}$	16	16	32	9	4

49. *A* TABLE, *ſhewing the Weights of equal Quantities of Matter, on the Surface of each Planet.*

	Weights.		Weights.
Sun	25	*Mars*	$\frac{1}{3}$
Mercury	$\frac{1}{96}$	*Jupiter*	2
Venus	$\frac{4}{5}$	*Saturn*	$1\frac{1}{3}$
Earth	1	*Moon*	$\frac{1}{3}$

50. *A* TABLE, *ſhewing the Mean Diſtances of* Saturn's *Satellites from his Centre, in Diameters of his Ring; and the Times of their Revolutions.*

The Diſtance of *Saturn*'s Ring from his Body		21.000 Miles.
Breadth or Thickneſs of the Ring	—	21.000
Diameter of the Ring paſſing thro' *Saturn*		152.000
Inclination of the Ring to the Ecliptic		31°.

Satellites.	Diſtances.	Revolutions.			
		Days.	Hrs.	′	″
Firſt	$\frac{19}{20}$	1	21	18	26
Second	$1\frac{1}{5}$	2	17	41	10
Third	$1\frac{7}{10}$	4	12	25	10
Fourth	4	15	22	41	28
Fifth	$11\frac{13}{14}$	79	7	46	0

51. *A* TABLE, *ſhewing in how long Time each of the Planets are conjoined with the* Sun.

Mercury,	in a Conjunction of the ſame Kind, in	115 Days.
Venus,	in a Conjunction of the ſame Kind, in	584 Days.
Mars,	in Conjunction with the Sun, every	780 Days.
Jupiter,	in Conjunction with the Sun, every	398 Days.
Saturn,	in Conjunction with the Sun, every	378 Days.

52. *A* TABLE, *ſhewing how many Degrees the Sun is uſually under the Horizon, before the Planets and Stars appear.*

Moon is often ſeen in the Day-time.	
Venus when horned about — —	5°.
Jupiter and *Mercury* — —	10°.
Saturn and *Mars* — —	11°.
Stars of the Firſt Magnitude —	12°.
Second — — —	13°.
Third — — —	14°.
Fourth — —	15°.
Fifth — — —	16°.
Sixth — — —	17°.
Beginning and End of Twilight —	18°.

53. *A* TABLE, *ſhewing the Increaſe of Heat toward the Equinoctial Line, and its Decreaſe toward the Poles, when the Sun is in the Equator; according to the Obliquity of the ſolar Rays.*

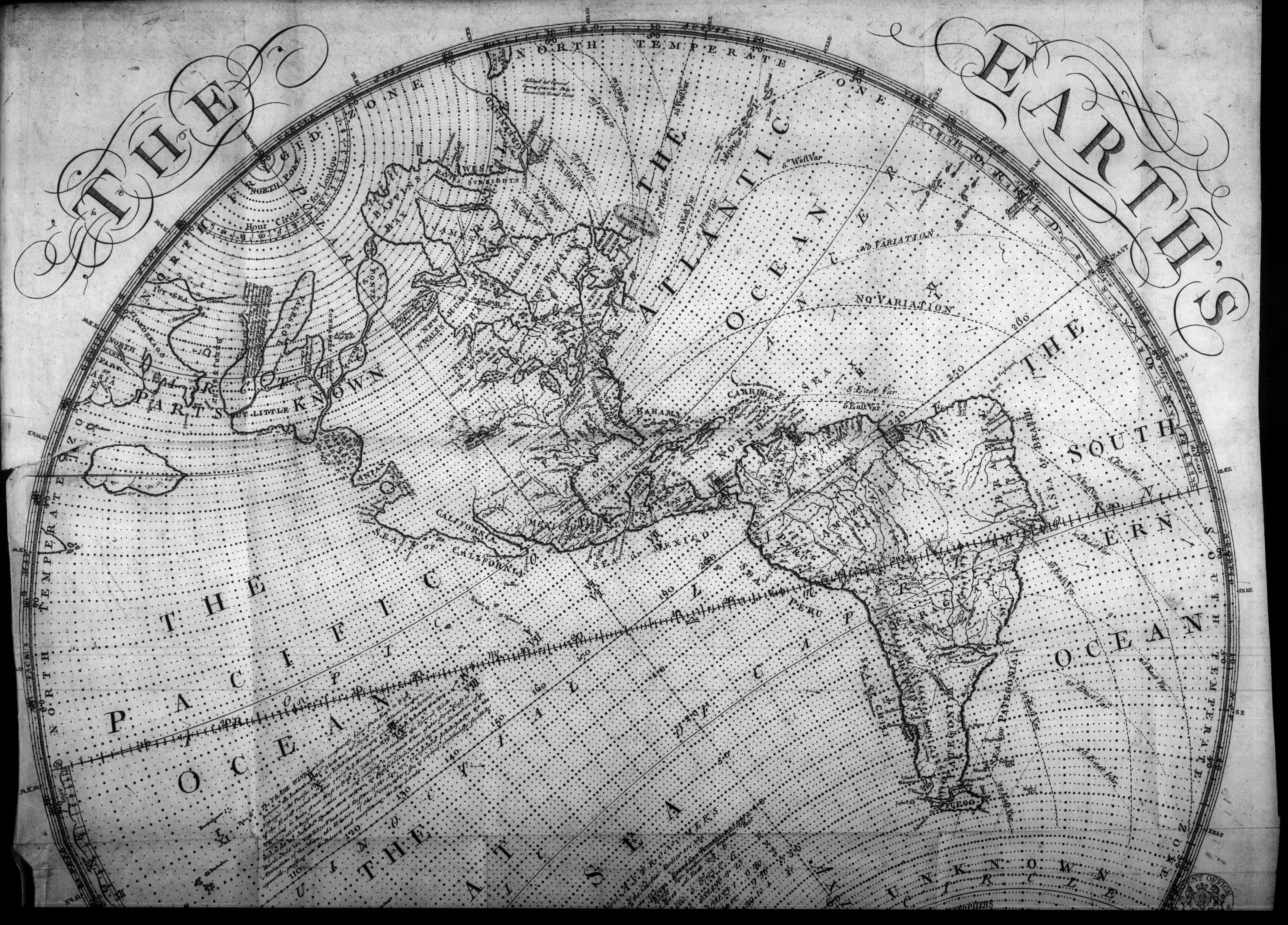
Latitude.		Quantity of Heat.
0°	———	20.000
11	———	19.696
20	———	18.796
30	———	17.321
40	———	15.321
50	———	12.155
60	———	10.000
70	———	6.140
80	———	3.473
90	———	0.000

This Table will be alike uſeful for any Time when the Sun is not in the Equator, if due Allowance be made for his Declination.

54. *A* TABLE, *ſhewing when* Venus *and* Mercury *may be ſeen in the Sun's Diſque, and at what Diſtance from his Centre.*

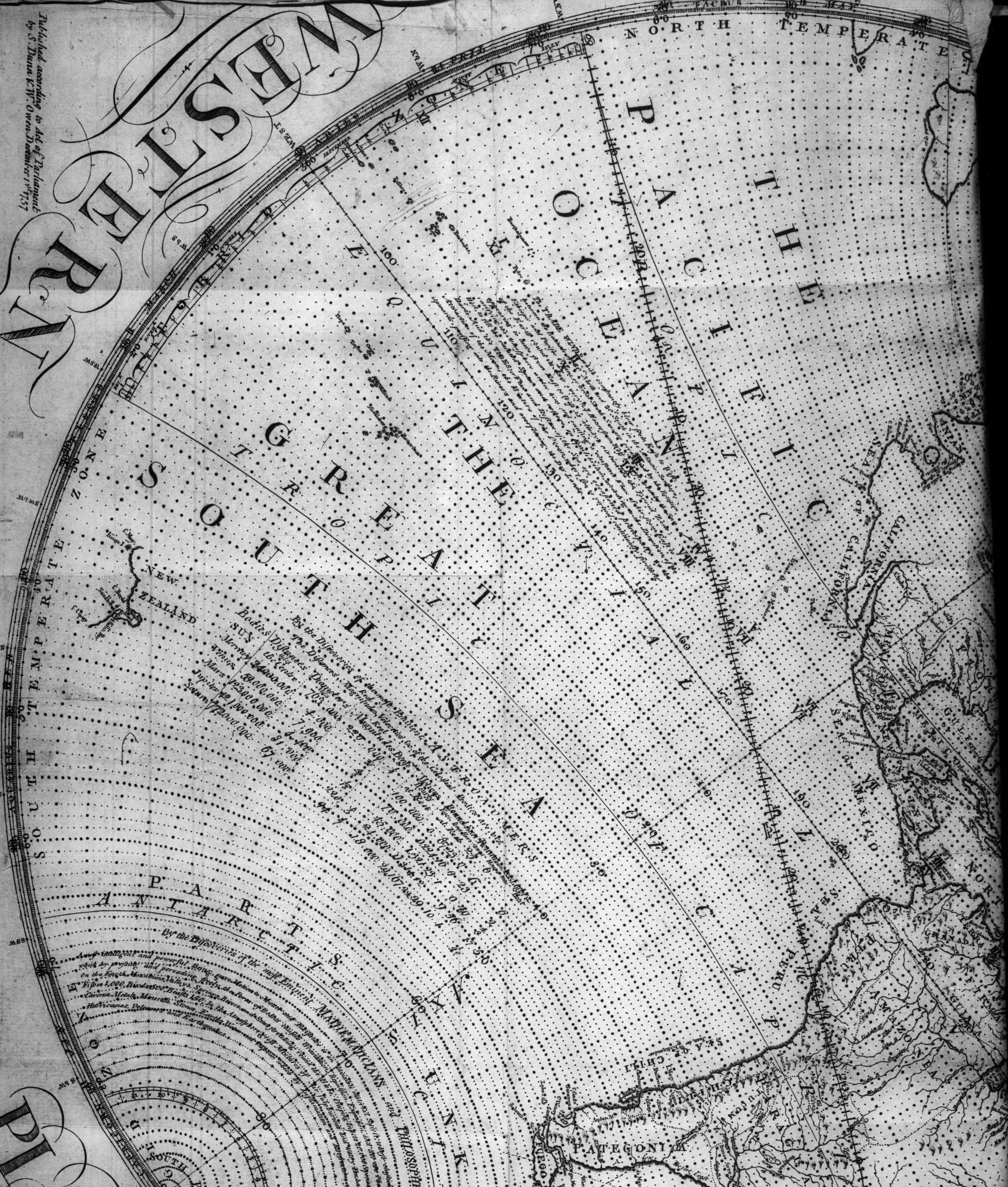
Planets.	Times.		h	m		Central Diſtance. ′	″	
Venus	1761	*June* 6,	5	55	Morn.	4	15	above.
Venus	1769	*June* 6,	11	0	Even.	15	43	below.
Mercury	1769	*Nov.* 9,	10	10	Even.	7	24	below.
Mercury	1776	*Nov.* 2,	10	19	Even.	15	23	above.
Mercury	1782	*Nov.* 12,	3	44	Even.	15	27	below.
Mercury	1786	*May* 4,	6	57	Morn.	12	43	below.
Mercury	1789	*Dec.* 6,	3	53	Even.	7	20	above.
Mercury	1799	*May* 7,	2	34	Aftern.	4	12	above.
Venus	1996	*June* 10,	1	13	Aftern.	13	36	above.
Venus	2004	*June* 8,	7	18	Morn.	6	22	below.
Venus	2109	*Dec.* 13,	2	56	Aftern.	14	36	below.
Venus	2117	*Dec.* 11,	4	3	Morn.	10	5	above.

TABLES *of the Comets, and alſo Tables for finding the Moon's Place, and thereby the Tides for many Years to come, are inſerted farther on.*


THE EARTH'S
NORTH TEMPERATE ZONE
NORTH FRIGID ZONE
NORTH POLE
Hour Circle for London
PARTS BUT LITTLE KNOWN
BAFFINS BAY
DAVIS STRAIGHTS
WEST GREENLAND
HUDSONS BAY
NEW N. WALES
LABRADOR OR NEW BRITAIN
CANADA
BAHAMA
GULF OF MEXICO
MEXICO OR NEW SPAIN
CALIFORNIA
SEA OF CALIFORNIA
SEA OF MEXICO
CARRIBEE SEA
NORTH
THE ATLANTIC OCEAN
NO VARIATION
5 East Var
5 West Var
10 West Var
15 West Var
20 West Var
AZORES
TERRA FIRMA
GUIANA
AMAZONIA
PERU
SEA OF PERU
PARAGUAY
BRASIL
SEA OF BRAZIL
CHILI
PATAGONIA
SEA OF PATAGONIA
FUEGO
THE SOUTHERN OCEAN
SOUTH TEMPERATE ZONE
THE PACIFIC OCEAN
THE TROPIC OF CANCER
THE EQUINOCTIAL
THE TROPIC OF CAPRICORN
THE ATLANTIC SEA
UNKNOWN
240
250
260
110
120
130
140
150
160
170
180
190
200

WESTERN PLANISPHERE

Published according to Act of Parliament
by S. Dunn & W.^m Owen December 1.^st 1757



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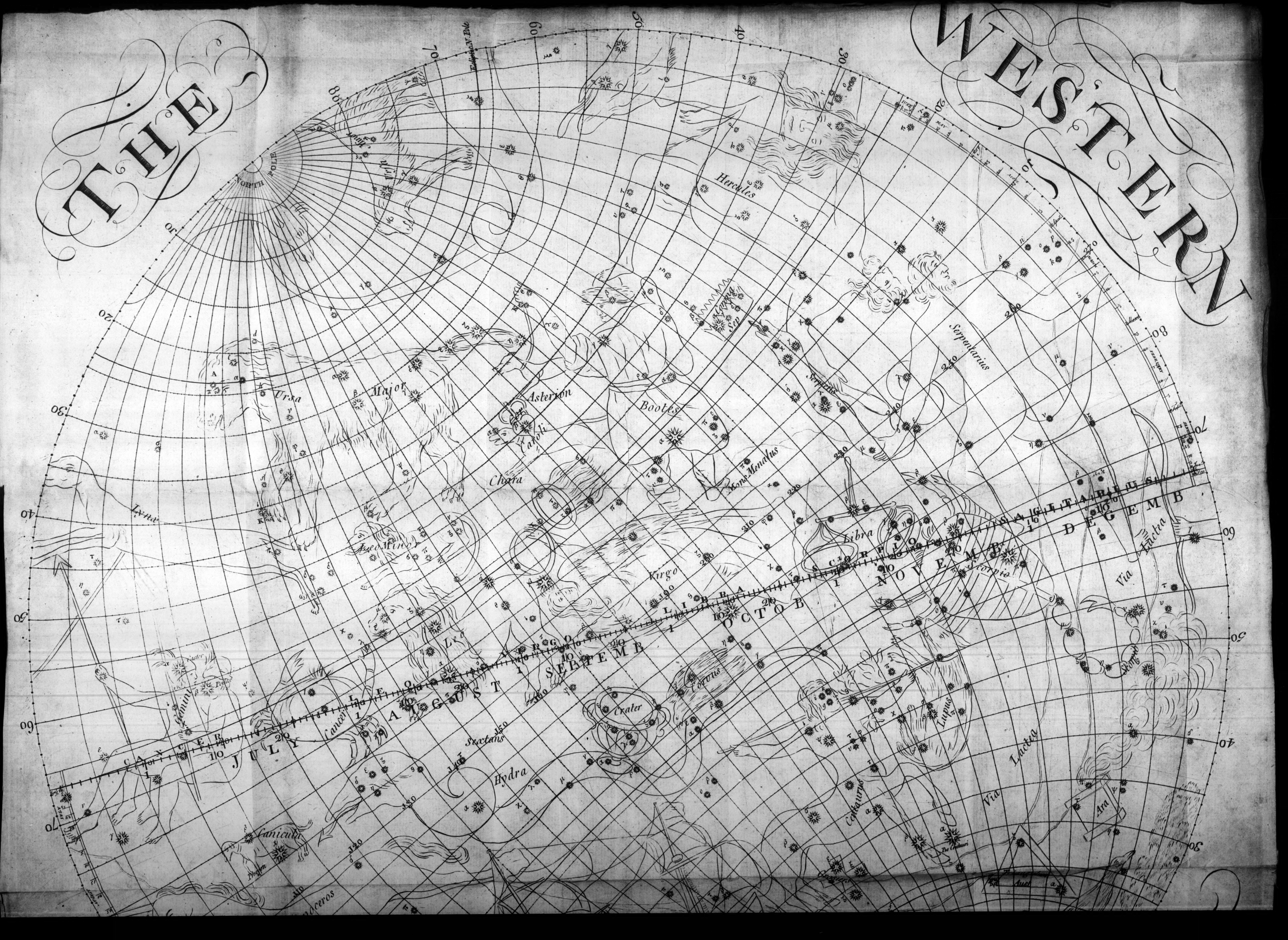
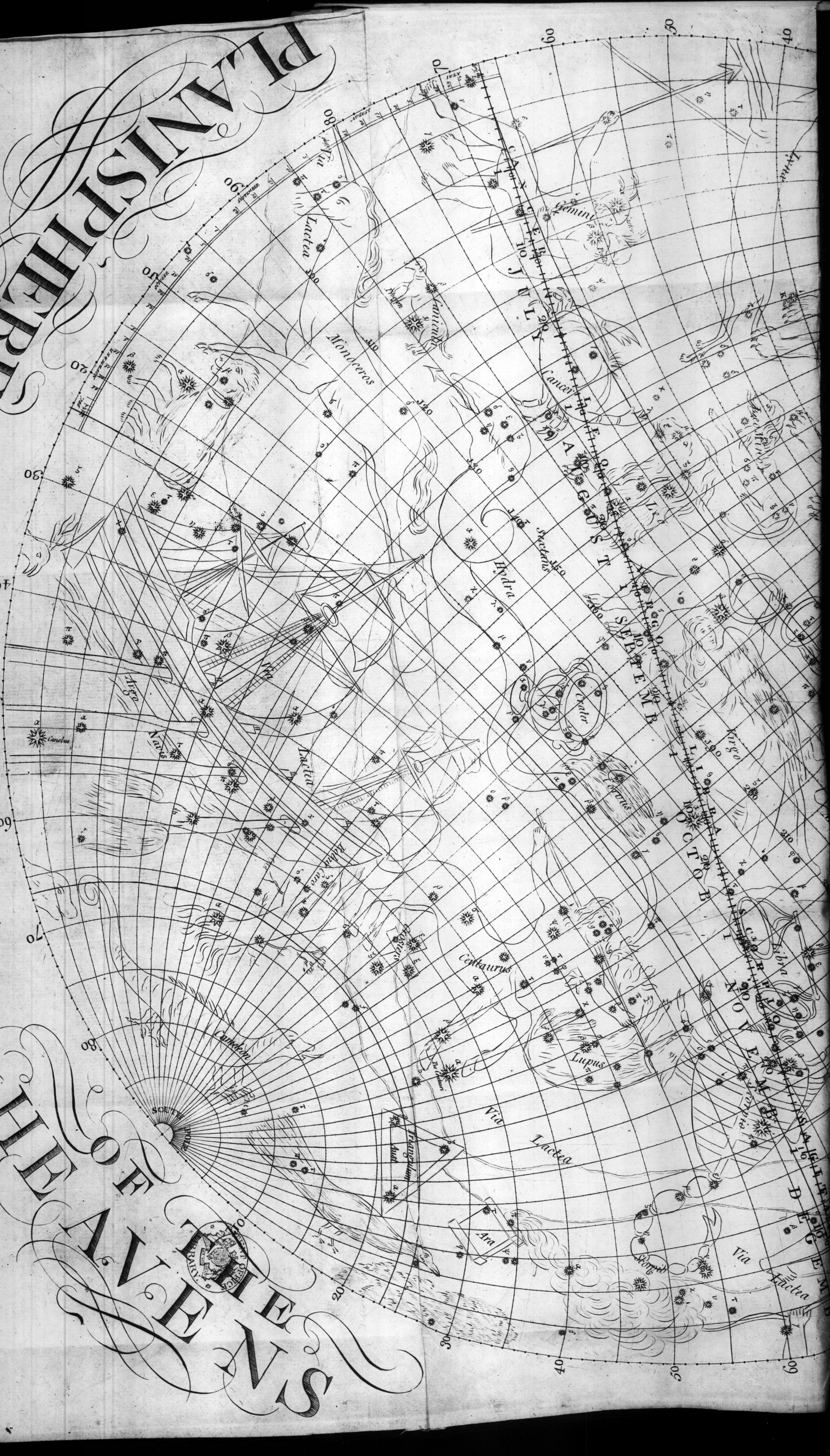
THE WESTERN


NORTH POLE
Ecliptic N. Pole
Ursa Minor
Ursa Major
Lynx
Leo Minor
Asterion
Cor Caroli
Chara
Bootes
Mons Menalus
Corona Sep
Hercules
Serpens
Serpentarius
Leo
Virgo
Libra
Scorpio
Corvus
Crater
Sextans
Hydra
Canicula
Procyon
Gemini
Castor
Pollux
Centaurus
Lupus
Ara
Via Lactea
CANCER
LEO
VIRGO
LIBRA
SCORPIO
SAGITTARIUS
JULY
AUGUST
SEPTEMB
OCTOB
NOVEMB
DECEMB

PLANISPHERE OF THE HEAVENS

Published according to Act of Parliament by S. Dunn & W. Owen December 1st 1757.



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GEOGRAPHICAL DEFINITIONS.

5. HAVING in the foregoing Part of this Treatiſe, given a particular Account of the Laws, Periods, Diſtances, Velocities and other Affections of the celeſtial Bodies, and ſhewn how the various Pheomena of the Earth and Heavens do primarily ariſe from the ſtabliſhed Laws of Matter and Motion; I ſhall now introduce ch Definitions as are neceſſary for underſtanding the Sciences f Geography, Aſtronomy, and others depending on them. nd, becauſe in the Conſtruction of the terreſtrial and celeſtial lobes, of which the univerſal Planiſpheres are Repreſentatives, d in all Treatiſes of their Uſes, a peculiar Reſpect has been d to the apparent Motion of the Sun, Moon and Stars round r Earth in 24 Hours, although at the ſame Time there be ot wanting ſufficient Evidence to evince that this Phenomenon principally owing to the Motion of the Earth itſelf: I ſhall erefore, for the Sake of Eaſe and Analogy, introduce the ſes of theſe Planiſpheres upon the ſame Plan.

56. A *Circle*, great or ſmall, is ſuppoſed to be divided into 60 equal Parts, called Degrees, each of theſe Degrees into 60 qual Parts, called Minutes, and each of theſe Minutes into 60 qual Parts, called Seconds. And when a Circle is the greateſt at can be drawn on the Surface of a Globe, it is called a *great ircle*, but otherwiſe, a *leſſer Circle* of the Sphere. The Earth ath two Points in its Surface, diametrically oppoſite to each her, called its Poles, the one North, the other South. A raight Line, drawn from Pole to Pole, and through the Cene of the Earth, is called the *Earth's Axis*, or Axis of the orld. The *Equinoctial*, or Earth's Equator, is a great Circle, ving all its Parts 90 Degrees from each Pole, and dividing Surface of the Earth's Globe into two Hemiſpheres, the North, the other South. *Meridians* are great Circles paſg through the two Poles, and dividing the Earth into two miſpheres, the one Eaſt, the other Weſt. The *ſenſible Hoizon*, is that Circle which divides the upper and viſible Part of e Heavens from the loweſt and inviſible. The *rational Hori-*

zon is parallel to the ſenſible Horizon, but below it, by half the Earth's Diameter. The *Tropic* of *Cancer* is a leſſer Circle, 23½ Degrees North of the Equinoctial, and parallel therewith. The *Tropic* of *Capricorn* is a leſſer Circle, 23½ Degrees South of the Equinoctial, and parallel therewith. The *Arctic Circle* is a leſſer Circle, 23½ Degrees from the North Pole, and the Antarctic Circle is a leſſer Circle, 23½ Degrees from the South Pole. The Poles, Axis, Equator, Tropics and polar Circles being extended into the Heavens, have like Names for the celeſtial Sphere.

57. The *torrid Zone*, is all that Space of the Earth and Sea between the Tropics of *Cancer* and *Capricorn*. The *North temperate Zone*, is that Space between the Tropics of *Capricorn* and the arctic Circle. The *South temperate Zone*, is that Space between the Tropic of *Capricorn* and the antarctic Circle. The *North frigid Zone*, is that Space between the North Pole and the arctic Circle. And the *South frigid Zone*, is that Space between the South Pole and the antarctic Circle. The *Latitude* of a Place, is its Diſtance from the Equator on a Meridian in Degrees and Minutes. *Parallels* of *Latitude* are leſſer Circles parallel to the Equinoctial. The *Longitude* of a Place, is the Number of Degrees and Minutes from the Place to a firſt Meridian, counting on a parallel of Latitude. *Difference of Latitude*, is the Number of Degrees and Minutes which one Place lieth more North or South than the other. And *Difference of Longitude*, is the Number of Degrees and Minutes of Longitude, which one Place lieth more Eaſt or Weſt than the other.

58. *Climates* are certain Spaces, each of which is contained between two parallels of Latitude, the longeſt Day in the Middle of one Climate being half an Hour longer or ſhorter than the longeſt Day in the Middle of the next adjacent Climate. There are 48 of theſe, 24 from the Equator to each Pole. Beſides which, there are 12 others, 6 from each polar Circle to its Pole,. whoſe Breadths are ſuch, that the Sun appears to one a Month ſooner than it appears to the next adjacent one, in his Return from the remoter Pole. *Amphiſcii*, are ſuch as inhabit the torrid Zone, their Shadows being caſt either North or South. *Periſcii*, are ſuch as inhabit the frigid Zone, their Shadows moving round them. *Heteroſcii*, are ſuch as inhabit the temperate Zones, their Shadows being caſt only one Way. *Antoecii*, are ſuch Inhabitants as live under the ſame Meridian, but on different Sides of the Equator, and equally diſtant therefrom; having the ſame Hour of Day or Night. *Perioecii*, are ſuch In-

Inhabitants as live in the ſame Parallel of Latitude, but on different Sides of the ſame Meridian, their difference of Longitude being 180 Degrees. *Antipodes*, are ſuch Inhabitants as are diametrically oppoſite to each other on different Sides of the Earth's Globle.

59. A *right Sphere*, is when the Poles of the World are in the Horizon. A *parallel Sphere*, is when the Equator is in the Horizon. An *oblique Sphere*, is when neither the Poles nor the Equator are in the Horizon. When a Perſon faceth the North Point of the Horizon, his Right-hand directs toward the *Eaſt*, his Left-hand toward the *Weſt*, and behind him is the *South*. Theſe are called the four Cardinal Points, between which are ſeven others, making in all 32, being 11 ¼ Degrees diſtant from each other, as in the following Tables. Of the Cardinal Points, *Geographers* reſpect the North, *Aſtronomers* the South, *Augurs* the Eaſt, *Poets* the Weſt. *Bearing*, is that Point of the Compaſs on which one Place lieth from another. *Diſtance*, is the Number of Miles or Degrees of the Equator, meaſuring from one Place to another. *Rhombs*, ſometimes called Loxodromiques, are curve Lines, leading from one Place to another, and cutting all the Meridians through which they paſs at equal Angles.

60. A *Continent*, is a great Extent of Earth, not divided by the Sea, having many Countries and Kingdoms. And an *Ocean*, or Sea, is a great and general Collection of Waters. An *Iſland*, is a Part of the Earth encompaſſed round with Water. And a *Lake*, is a Tract of Water encompaſſed by Lands. A *Promontory*, is a Part of the Continent extending itſelf into the Ocean. And a *Bay*, is a Part of the Ocean extending itſelf between Lands. A *Peninſula*, is a Part of the Earth almoſt ſurrounded by Water, but joined to the Continent by a narrow Neck of Land, called an *Iſthmus*. And a *Gulph*, is a Part of the Ocean almoſt ſurrounded by Lands, but joined to the Ocean by a narrow Neck of Water, called a *Streight*. Mountains, Vallies, Moraſſes, Rivers, Rivulets, Springs, *&c.* are generally well known, and therefore need not to be placed with the aforegoing Definitions.

ASTRONOMICAL DEFINITIONS.

61. THE celeſtial *Equator*, is a great Circle in the Heavens, coincident with the Plane of the Earth's Equator produced, and dividing the Heavens into two equal Parts, called the northern and ſouthern *Hemiſpheres*. The *Poles* of the celeſtial Equator are two Points in the Heavens, diametrically oppoſite to each other, the one above the Horizon, and the other below the Horizon in any Latitude. The *Axis* of the *World*, is an imaginary Line drawn thro' the Earth's Centre from Pole to Pole. The celeſtial *Meridians* are great Circles croſſing the Equator and meeting at the Poles. The *Ecliptic*, is a great Circle cutting the Equator in two oppoſite Points under an Angle of 23½ Degrees, and having the 12 Signs, *Aries* ♈, *Taurus* ♉, *Gemini* ♊, *Cancer* ♋, *Leo* ♌, *Virgo* ♍, *Libra* ♎, *Scorpio* ♏, *Sagittarius* ♐, *Capricorn* ♑, *Aquarius* ♒, *Piſces* ♓. The *Zodiac* is a Zone or Belt, 18½ Degrees broad, on each Side of the Ecliptic 9¼, in ſome Part of which Space the Planets are always found.

The *Equinoctial Colure*, is a Meridian paſſing through the Beginning of *Aries* and *Libra*, or where the Ecliptic cuts the Equator. And the *Solſticial Colure*, is a Meridian paſſing thro' the Beginning of *Cancer* and *Capricorn*. The *Poles* of the *Ecliptic* are two Points in the Heavens diametrically oppoſite to each other, 23½ Degrees diſtant from the Poles of the World, and 90 Degrees diſtant from the Ecliptic itſelf. The *Latitude* of a Star, is the Star's neareſt Diſtance from the Ecliptic. And the *Longitude* of a Star, is the Number of Degrees and Minutes contained between the Star and a great Circle paſſing thro' the Poles of the Ecliptic and the Beginning of *Aries*, counting in that parallel to the Ecliptic in which the Star is, from *Aries* to *Taurus*, &c.

62. The *Tropic* of *Cancer*, is a leſſer Circle of the Heavens parallel to the Equator, and 23½ Degrees North therefrom. The *Tropic* of *Capricorn*, is a leſſer Circle of the Heavens, parallel to the Equator, and 23½ Degrees South therefrom. The *Arctic Circle*, is a leſſer Circle of the Heavens, 23½ Degrees diſtant from the North Pole. And the *Antarctic Circle*, is a

leſſer Circle of the Heavens, 23 ½ Degrees from the South Pole. The *Zenith*, is that Point of the Heavens, directly over our Heads. And the *Nadir*, is that Point of the Heavens, directly under our Feet. *Amplitude*, is that Point of the Horizon, where a celeſtial Body riſes or ſets, counting from the Eaſt or Weſt in Degrees and Minutes. *Azimuth*, is that Part of the Horizon, perpendicularly below or above any celeſtial Phenomenon, counting from the North or South Points of the Horizon, in Degrees and Minutes. *Vertical Circles*, are great Circles, paſſing from the Zenith to the Nadir, and cutting the Horizon at right Angles. *Almacanthars*, or parallels of Altitude, are leſſer Circles parallel to each other from the Horizon to the Zenith. *Parallels* of Declination, are leſſer Circles parallel to the Equator from the Equator to the Poles. The *Latitude* of a Place, is the Height of the Pole above the Horizon, or the Diſtance from the Equator to the Zenith. The *Altitude* of a celeſtial Body, is its Height above the Horizon in Degrees and Minutes. The *Declination* of a celeſtial Body, is its Diſtance from the Equator in Degrees and Minutes.

63. *Right Aſcenſion*, is ſo much of the Equator as cometh to the Meridian with the Sun or Star, counting from the Beginning of *Aries*, or where the Ecliptic cuts the Equator. *Oblique Aſcenſion*, is ſo much of the Equator as riſeth with the Sun or Star. And *Oblique Deſcenſion*, is ſo much of the Equator as ſets with the Sun or Star, counting as above. *Aſcenſional Difference*, is the Difference between the Right and Oblique Aſcenſion. *Parallax*, is the Difference between the apparent and true Place of a celeſtial Body, the former as ſeen from the Earth's Surface, the latter as eſtimated from the Earth's Centre. *Refraction*, is the Elevation of a celeſtial Body, apparently in Altitude, whereby it appears to riſe ſooner and ſet later than it really doth. *Coſmical Riſing* or *Setting* of a Star, is when the Star riſes or ſets when the Sun riſes. *Anchronical Riſing* or *Setting*, is when the Star riſes or ſets when the Sun ſets. *Heliacal Riſing*, is when a celeſtial Body hath been near the Sunbeams, and is viſible before Sun-riſing. And *Heliacal Setting*, is when the celeſtial Body ſets inconſpicuous with the Solar Rays.

64. A *ſpherical Triangle*, is a three-cornered Figure, whoſe three Sides are Arches of a great Circle of the Earth or Heavens. A *ſpherical Angle*, is meaſured by the Arch of a great Circle, paſſing from one of the Sides next the Angle to the other, at

thoſe Sides produced, at the Diſtance of 90 Degrees from the angular Point. *Projection of the Sphere in Plano*, or on a Plane, is the Delineation of half a Sphere or Globe, as it would appear, was an Eye at reſt, a tranſparent Plane interpoſed between the Eye and Sphere at right Angles to the Axis of Viſion, and all the Parts of the half Sphere, as ſeen by the Eye, delineated on the Plane. A *Planiſphere*, is a Projection of the Sphere upon a Plane, and if it be that of the Earth, it is called a *terreſtrial Planiſphere*, but if it be that of the Heavens, it is called a *celeſtial Planiſphere*.

Univerſal Planiſpheres, are ſuch as will ſupply the Uſes of the terreſtrial and celeſtial Globes, or Models of the Earth and Heavens, with all the real and imaginary Lines belonging to them; and ſolve the Problems of Geography, Aſtronomy and other Sciences depending on theſe, by the Help of proper Data. An *eaſtern terreſtrial Planiſphere*, is an eaſtern Hemiſphere of the Earth, projected on the Plane of its Meridian. A *weſtern terreſtrial Planiſphere*, is a weſtern Hemiſphere of the Earth, projected on the Plane of its Meridian. An *eaſtern celeſtial Planiſphere*, is an eaſtern Hemiſphere of the Heavens, projected on its Meridian. A *weſtern celeſtial Planiſphere*, is a weſtern Hemiſphere of the Heavens, projected on its Meridian. A *Slider*, *Index*, or *Projector*, is a Projection only of the Meridians, Equator and its Parallels.

65. *Chronology*, is a Science whereby we underſtand the Parts of Time or Duration by the Motions of the celeſtial Bodies. A natural *Day* contains 24 equal Diviſions, called Hours. An *Hour* contains 60 equal Diviſions, called Minutes. And a *Minute* contains 60 equal Diviſions, called Seconds. A *Year*, is that Space of Time in which the Earth makes one Revolution in its Orbit. A *Solar Year*, is that Space of Time which the Sun apparently takes in departing from one Place in the Heavens and returning to it again, this is, 365 Days, 5 Hours, 48 Minutes, 57 Seconds. A *ſiderial Year*, is that Space of Time in which the Sun returns to the ſame Poſition with reſpect to the fixed Stars, and this is 365 Days, 6 Hours, 9 Minutes, 14 Seconds. The *Lunar Year*, is that Space of Time in which the Moon makes 12 Revolutions round the Earth, which ſhe doth in 354 Days, 8 Hours, 48 Minutes, 38 Seconds. The *Epact*, is the Space of 11 Days, being the Difference between the Solar and the Lunar Year. A *Julian Year*, is 365 Days, 6 Hours, or 365 Days, three ſucceeding Years, and 366 Days, every fourth Year, which is

called *Biſſextile* or *Leap-year*. A *Gregorian Year*, is the ſame as a *Julian* Year, only it begins the firſt of *January*, whereas the *Julian* Year begins the twenty-fifth of *March*, and, as in the *Julian* Account, every hundredth Year is a *Leap-year*, ſo in the *Gregorian* Account, every four hundredth Year is a common Year. *France*, *Spain*, *Portugal*, *Italy*, *Poland*; the Popiſh Electors in *Germany*, and moſt other Places uſe the *Gregorian* Account or New-ſtile, and *England* changed from the *Julian* or Old-ſtile to the New, 2 *September* 1752, calling the next Day *September* 14. The *Anticipation* of the *Equinoxes*, is 11 Minutes, 3 Seconds *per Annum*, being the Difference between the *Julian* and ſolar Year, whereby the equinoctial Points are carried backward, or the Sun carried forward a Day in 131 Years.

66. A *Lunar* ſynodical *Month*, is the Space of Time in which the Sun and Moon are parted and conjoined apparently after one Revolution, and this is 29 Days, 12 Hours, 44 Minutes, 3 Seconds. A *Lunar periodical Month*, is that Space of Time in which the Moon returns to the ſame Place of the Ecliptic, and this is 27 Days, 7 Hours, 43 Minutes, 8 Seconds. A *civil Month*, is from 28 to 31 Days. An *artificial Day*, is the Space of Time from Sun-riſing to Sun-ſetting. An *aſtronomical Day*, is the Time in which the Sun apparently leaves the Meridian and returns to the ſame again. A *civil Day* begins with the *Jews*, *Greeks*, *Bohemians*, *Italians* and *Chineſe*, at Sun-ſetting; with the *Perſians* and *Syrians*, at Sun-riſing; with the *Egyptians*, *Romans*, *Engliſh*, *French*, *Spaniards*, *Germans* and *Dutch*, at Midnight; with the *Arabians* and modern Aſtronomers, at Noon; and ends at the Beginning of the ſucceeding Day. *Equal Time*, is that meaſured out by Clocks or Watches. *True Time*, is that meaſured out by the unequal apparent Motion of the Sun, or rather the Motion of the Earth in its Orbit.

67. The Cycle of the Sun, is 4 Times 7, or 28 Years, in which Space of Time the Dominical or *Sunday* Letters *A*, *B*, *C*, *D*, *E*, *F*, *G*, do make all their Varieties with the Days of the Month according to the *Julian* Account. But as this Cycle is 11 Minutes and 3 Seconds of Time ſlower *per Annum*, than the ſolar Year, the *Julian* Account, in every 130 $\frac{1}{3}$ Years, muſt be a Day later than the Sun. Hence, although at the *Nicene* Council, *Anno Dom.* 325, the Equinox was *March* 21, *Anno Dom.* 1582, it was *March* 11, when Pope *Gregory* added 10 Days, and directed as above.

68. A *Lunar Cycle*, otherwiſe called the Golden-number, is the Space of 19 Years, propoſed by *Meton*, 432 Years before Chriſt, and which has been continued in the *Julian* Account, for ſhewing all the Poſitions or Aſpects which the Sun and Moon can make with each other; and for ſettling *Eaſter-day* the firſt *Sunday* after the firſt full Moon, happening after the twenty-firſt Day of *March*, or vernal Equinox. But this Number hath been found defective, by 1 Day in 304 Years; and ſeeing it is now near 4¾ Times 304, or near 1444 Years ſince the *Nicene* Council; therefore the new Moons according to this Cycle, do happen about 4¾ Days ſooner than they really do in the Heavens.

69. A *Chaldean Saros*, is that Space of Time in which the Sun and Moon make all their various Poſitions or Aſpects to each other, with reſpect to the Earth. This is performed with but little Inequalities in 223 Lunations, or 18 Years, 10 Days, 7 Hours, 43 Minutes, 30 Seconds. Therefore, add theſe Years, Days, Hours and Minutes, to the Day, Hour and Minute of a new Moon, full Moon, Eclipſe of the Sun or Moon, and you have the Time when that Lunation or Eclipſe will return with much the ſame Circumſtances as before. Thus much may ſuffice for the Definitions of Time; indeed the Antients uſed other Periods, but they were much leſs certain than the *Julian*, whoſe Simplicity and Certainty is ſuch, that for the Purpoſes of Aſtronomy, it ſeems to be preferable to the *Gregorian* itſelf.

70. *A* Table, *ſhewing how many Days muſt be added to the* Julian *Account, for reducing it to the* Gregorian.

1700	*Leap-year*	11 Days	2800	*Leap-year*	19 Days
1800	———	12	2900	———	20
1900	———	13	3000	———	21
2000	*Leap-year*	13	3100	———	22
2100	———	14	3200	*Leap-year*	22
2200	———	15	3300	———	23
2300	———	16	3400	———	24
2400	*Leap-year*	16	3500	———	25
2500	———	17	3600	*Leap-year*	25
2600	———	18	3700	———	26
2700	———	19	3800	———	27
			3900	———	28, &c.

71. A

TABLE,

SHEWING

The Sun's Place in the ECLIPTIC, Right ASCENSION, DECLINATION and EQUATION of TIME for every Day in the BISSEXTILE Year, 1760.

ALSO,

His apparent Diameter, hourly Motion, Time in tranſiting the Meridian, and Diſtance from the Earth in Miles, every tenth Day.

Note. This Table being calculated for the Year 1760, New-Style, and the Meridian of *London*, may be readily uſed for any other Year of the preſent Age, adding 1′ 48″ for every ſucceeding *Biſſextile* Year, and ſubtracting 14′ 20″ for every Year after *Leap* Year, the Sum or Remainder ſhews the Sun's Place for that Day; oppoſite to which, or by a proportional Difference, you have the Right Aſcenſion and Declination required.

Numbers to be added to, or ſubtracted from the Sun's Place, in the following Table, from 1 to 40 Years; beſides, which, for an exact Determination, a proportional Allowance ſhould be made for any Part of a Year.

	′	″		′	″		′	″		′	″
1 ſub.	14	20	11 ſub.	39	24	21 ſub.	5	20	31 ſub.	30	41
2 ſub.	28	40	12 add	5	24	22 ſub.	19	40	32 add	14	24
3 ſub.	43	0	13 ſub.	8	56	23 ſub.	34	0	33 ſub.	0	4
4 add	1	48	14 ſub.	23	16	24 add	10	48	34 ſub.	14	24
5 ſub.	12	32	15 ſub.	37	36	25 ſub.	3	32	35 ſub.	28	44
6 ſub.	26	52	16 add	7	12	26 ſub.	17	52	36 add	16	12
7 ſub.	41	12	17 ſub.	7	8	27 ſub.	32	12	37 add	1	50
8 add	3	36	18 ſub.	21	8	28 add	12	36	38 ſub.	12	30
9 ſub.	10	44	19 ſub.	35	48	29 ſub.	1	44	39 ſub.	26	50
10 ſub.	25	40	20 add	9	0	30 ſub.	16	4	40 add	18	0

JANUARY.

Month-day.	Sunday Lett.		⊙ Place.				Right Aſcenſion.			Declination.			Clocks bef. ⊙.	
			S.	D	M.	S.	D.	M.	S.	D.	M.	S.	M.	S.
1	*a*		♑	10	36	37	281	32	37	23	2	51	3 B	59
2	*b*			11	37	48	282	38	50	22	57	45	4	28
3	*c*			12	39	0	283	45	1	22	52	12	4	56
4	*d*			13	40	12	284	51	5	22	46	11	5	23
5	*e*			14	41	23	285	57	2	22	39	42	5	50
6	*f*			15	42	35	287	2	53	22	32	46	6	5
7	*g*			16	43	46	288	8	37	22	25	23	6	43
8	*a*			17	44	56	289	14	13	22	17	34	7	9
9	*b*			18	46	7	290	19	43	22	9	20	7	34
10	*c*			19	47	17	291	25	5	22	0	40	7	59
11	*d*			20	48	26	292	30	17	21	51	33	8	24
12	*e*			21	49	35	293	35	20	21	42	1	8	47
13	*f*			22	50	44	294	40	14	21	32	4	9	10
14	*g*			23	51	51	295	44	57	21	21	42	9	32
15	*a*			24	52	58	296	49	30	21	10	55	9	54
16	*b*			25	54	5	297	53	53	20	59	44	10	15
17	*c*			26	55	11	298	58	6	20	48	9	10	35
18	*d*			27	56	16	300	2	8	20	36	10	10	55
19	*e*			28	57	21	301	6	0	20	23	48	11	14
20	*f*			29	58	25	302	9	40	20	11	2	11	32
21	*g*		♒	0	59	28	303	13	9	19	57	53	11	49
22	*a*			2	0	30	304	16	26	19	44	23	12	6
23	*b*			3	1	31	305	19	31	19	30	31	12	21
24	*c*			4	2	32	306	22	25	19	16	17	12	36
25	*d*			5	3	31	307	25	6	19	1	42	12	50
26	*e*			6	4	29	308	27	35	18	46	46	13	4
27	*f*			7	5	27	309	29	52	18	31	29	13	16
28	*g*			8	6	24	310	31	57	18	15	55	13	28
29	*a*			9	7	20	311	33	51	17	59	57	13	39
30	*b*			10	8	15	312	35	32	17	43	42	13	49
31	*c*			11	9	8	313	36	59	17	27	8	13	58

D.	Semi Diam. ⊙		Hourly Mot.			Tranſ. Mer.		⊙ Diſt. from Earth.
	′	″	′	″		′	″	Miles.
1	16	23	2	33	0	2	22	79.630290
11	16	22	2	32	8	2	21	79.996410
21	16	21	2	32	5	2	19	80.172180

FE-

FEBRUARY.

Month-day.	Sunday Lett.		☉'s Place.				Right Aſcenſion.			Declination.			Clocks bef. ☉.	
			S.	D	M.	S.	D.	M.	S.	D.	M.	S.	M.	S.
1	d		♒	12	10	0	314	38	14	17	10	15	14 B	7
2	e			13	10	50	315	39	16	16	53	3	14	14
3	f			14	11	39	316	40	6	16	35	35	14	21
4	g			15	12	27	317	40	44	16	17	50	14	27
5	a			16	13	14	318	41	10	15	59	48	14	32
6	b			17	13	59	319	41	23	15	41	29	14	36
7	c			18	14	43	320	41	24	15	22	54	14	40
8	d			19	15	25	321	41	12	15	4	3	14	43
9	e			20	16	6	322	40	48	14	44	57	14	45
10	f			21	16	45	323	40	12	14	25	37	14	46
11	g			22	17	23	324	39	24	14	6	3	14	46
12	a			23	18	0	325	38	25	13	46	15	14	45
13	b			24	18	36	326	37	15	13	26	13	14	44
14	c			25	19	9	327	35	54	13	5	57	14	42
15	d			26	19	41	328	34	21	12	45	29	14	38
16	e			27	20	11	329	32	37	12	24	49	14	36
17	f			28	20	39	330	30	41	12	3	57	14	32
18	g			29	21	6	331	28	35	11	42	53	14	27
19	a		♓	0	21	32	332	26	19	11	21	39	14	21
20	b			1	21	56	333	23	53	11	0	14	14	15
21	c			2	22	18	334	21	17	10	38	39	14	8
22	d			3	22	38	335	18	31	10	16	54	14	0
23	e			4	22	56	336	15	35	9	54	59	13	52
24	f			5	23	13	337	12	30	9	32	56	13	43
25	g			6	23	28	338	9	16	9	10	34	13	34
26	a			7	23	41	339	5	53	8	48	24	13	24
27	b			8	23	52	340	2	21	8	25	56	13	13
28	c			9	24	1	340	58	41	8	3	20	13	2
29	—			10	24	8	341	54	53	8	40	38	12	50

D.	Semi Diam. ☉		Hourly Mot.			Tranſ.Mer.		☉ Diſt. from Earth.
	′	″	′	″		′	″	Miles.
1	16	20	2	32	1	2	17	79·849800
11	16	18	2	31	5	2	15	79·996410
21	16	16	2	30	8	2	12	80.172180

MARCH.

Month-day.	*Sunday Lett.*	☉'s Place.				Right Aſcenſion.			Declination.			Clocks bef. ☉.	
		S.	*D.*	*M.*	*S.*	*D.*	*M.*	*S.*	*D.*	*M.*	*S.*	*M.*	*S.*
1	*d*	♓	11	24	14	342	50	57	7	17	50	12 B	38
2	*e*		12	24	18	343	46	54	6	54	55	12	25
3	*f*		13	24	20	344	42	44	6	31	54	12	12
4	*g*		14	24	20	345	38	27	6	8	48	11	58
5	*a*		15	24	18	346	34	3	5	45	36	11	44
6	*b*		16	24	14	347	29	33	5	22	20	11	30
7	*c*		17	24	8	348	24	57	4	59	0	11	15
8	*d*		18	24	0	349	20	15	4	35	36	10	59
9	*e*		19	23	49	350	15	26	4	12	10	10	44
10	*f*		20	23	37	351	10	32	3	48	40	10	28
11	*g*		21	23	23	352	5	34	3	25	7	10	11
12	*a*		22	23	8	353	0	32	3	2	31	9	55
13	*b*		23	23	50	353	55	26	2	37	53	9	38
14	*c*		24	22	29	354	50	15	2	14	14	9	20
15	*d*		25	22	7	355	45	2	1	50	34	9	3
16	*e*		26	21	43	356	39	44	1	26	53	8	45
17	*f*		27	21	17	357	34	25	1	3	12	8	28
18	*g*		28	20	49	358	29	2	0	39	30	8	10
19	*a*		29	20	19	359	23	36	0	15	48	7	51
									North.				
20	*b*	♈	0	19	47	0	18	9	0	7	54	7	33
21	*c*		1	19	12	1	12	39	0	31	34	7	14
22	*d*		2	18	36	2	5	8	0	55	12	6	56
23	*e*		3	17	57	3	1	36	1	18	48	6	37
24	*f*		4	17	16	3	56	3	1	42	23	6	19
25	*g*		5	16	34	4	50	30	2	5	55	6	0
26	*a*		6	15	49	5	44	56	2	29	25	5	41
27	*b*		7	15	1	6	39	21	2	52	52	5	22
28	*c*		8	14	12	7	33	48	3	16	16	5	4
29	*d*		9	13	22	8	28	16	3	39	36	4	45
30	*e*		10	12	29	9	22	44	4	2	52	4	26
31	*f*		11	11	34	10	17	13	4	26	2	4	8

D.	Semi Diam. ☉		Hourly Mot.			Tranſ Mer.		☉ Diſt. from Earth.
	′	″	′	″		′	″	Miles.
1	16	14	2	30	2	2	11	80.352810
11	16	11	2	29	4	2	10	80.570700
21	16	9	2	28	5	2	9	80.800740

APRIL.

APRIL.

Month day.	Sunday Lett.		☉'s Place.				Right Aſcenſion.			Declination.			Clocks bef. ☉	
			S.	D.	M.	S.	D.	M.	S.	D.	M.	S	M.	S.
1	*g*		♈	12	10	37	11	11	44	4	49	8	3 B	49
2	*a*			13	9	38	12	6	17	5	12	10	3	31
3	*b*			14	8	37	13	0	52	5	35	6	3	13
4	*c*			15	7	33	13	55	29	5	57	56	2	55
5	*d*			16	6	28	14	50	8	6	20	39	2	37
6	*e*			17	5	21	15	44	51	6	43	17	2	19
7	*f*			17	4	11	16	39	36	7	5	48	2	2
8	*g*			19	2	59	17	34	25	7	28	11	1	44
9	*a*			20	1	46	18	29	19	7	50	26	1	28
10	*b*			21	0	31	19	24	17	8	12	34	1	11
11	*c*			21	59	14	20	19	18	8	34	24	0	54
12	*d*			22	57	55	21	14	24	8	56	26	0	38
13	*e*			23	56	34	22	9	35	9	18	8	0	23
14	*f*			24	55	10	23	4	50	9	39	41	0	7
15	*g*			25	53	44	24	0	10	10	1	4	0 A	8
16	*a*			26	52	17	24	55	37	10	22	18	0	23
17	*b*			27	50	48	25	51	10	10	43	21	0	37
18	*c*			28	49	18	26	46	48	11	4	14	0	51
19	*d*			29	47	45	27	42	32	11	24	55	1	5
20	*e*		♉	0	46	11	28	38	23	11	45	26	1	18
21	*f*			1	44	34	29	34	20	12	5	46	1	31
22	*g*			2	42	56	30	30	23	12	25	54	1	43
23	*a*			3	41	15	31	26	32	12	45	49	1	55
24	*b*			4	39	33	32	22	50	13	5	31	2	6
25	*c*			5	37	49	33	19	16	13	25	1	2	17
26	*d*			6	36	4	34	15	49	13	44	18	2	27
27	*e*			7	34	16	35	12	26	14	3	20	2	37
28	*f*			8	32	27	36	9	16	14	22	9	2	47
29	*g*			9	30	36	37	6	10	14	40	44	2	55
30	*a*			10	28	43	38	3	12	14	59	6	3	4

D.	Semi Diam. ☉		Hourly Mot.			Tranſ. Mer.		☉ Diſt. from Earth.
	′	″	′	″		′	″	Miles.
1	16	5	2	27	6	2	8	81.059940
11	16	3	2	26	7	2	9	81.293220
21	16	0	2	25	9	2	10	81.516780

MAY.

Month-day.	*Sunday* Lett.		☉'s Place.				Right Aſcenſion.			Declination.			Clocks after ☉.	
			S.	*D.*	M.	*S.*	*D.*	*M.*	*S*	*D.*	*M.*	*S.*	*M.*	*S.*
1	*b*		♉	11	26	46	39	0	24	15	17	12	3	A 12
2	*c*			12	24	54	39	57	44	15	35	2	3	19
3	*d*			13	22	56	40	55	12	15	52	37	3	26
4	*e*			14	20	56	41	52	47	16	9	58	3	32
5	*f*			15	18	55	42	50	31	16	27	1	3	37
6	*g*			16	16	52	43	48	24	16	43	49	3	42
7	*a*			17	14	49	44	46	26	17	0	21	3	47
8	*b*			18	12	44	45	44	37	17	16	35	3	51
9	*c*			19	10	37	46	42	56	17	32	31	3	54
10	*d*			20	8	28	47	41	23	17	48	10	3	57
11	*e*			21	6	18	48	39	59	18	3	31	3	59
12	*f*			22	4	6	49	38	43	18	18	34	4	0
13	*g*			23	1	53	50	37	36	18	33	19	4	1
14	*a*			23	59	39	51	36	39	18	47	37	4	2
15	*b*			24	57	24	52	35	51	19	1	54	4	1
16	*c*			25	55	7	53	35	11	19	15	43	4	1
17	*d*			26	52	49	54	34	38	19	29	12	4	0
18	*e*			27	50	29	55	34	14	19	42	20	3	58
19	*f*			28	48	8	56	33	59	19	55	9	3	55
20	*g*			29	45	46	57	33	52	20	7	39	3	52
21	*a*		♊	0	43	22	58	33	53	20	19	48	3	49
22	*b*			1	40	58	59	34	3	20	31	35	3	45
23	*c*			2	38	32	60	34	20	20	43	1	3	40
24	*d*			3	36	5	61	34	45	20	54	6	3	35
25	*e*			4	33	37	62	35	18	20	4	50	3	29
26	*f*			5	31	8	63	35	57	21	15	12	3	23
27	*g*			6	28	37	64	36	43	21	25	12	3	17
28	*a*			7	26	6	65	37	36	21	34	49	3	10
29	*b*			8	23	34	66	38	37	21	44	5	3	2
30	*c*			9	21	0	67	39	46	21	52	58	2	54
31	*d*			10	18	26	68	41	2	22	1	28	2	46

D.	Semi Diam. ☉		Hourly Mot.			Tranſ. Mer.		☉ Diſt. from Earth
	′	″	′	″		′	″	Miles.
1	15	58	2	25	2	2	12	81.724120
11	15	55	2	25	5	2	13	81.910440
21	15	54	2	24	0	2	15	82.070010

JUNE.

Month-day.	*Sunday Lett.*		☉'s Place.				Right Aſcenſion.			Declination.			Clocks after ☉.	
			S.	*D.*	*M.*	*S.*	*D.*	*M.*	*S.*	*D.*	*M.*	*S.*	*M.*	*S.*
1	*e*		♊	11	15	51	69	42	24	22	9	35	2 A	37
2	*f*			12	13	15	70	43	50	22	17	19	2	28
3	*g*			13	10	38	71	45	22	22	24	40	2	18
4	*a*			14	8	1	72	47	0	22	31	38	2	8
5	*b*			15	5	23	73	48	43	22	38	13	1	58
6	*c*			16	2	44	74	50	30	22	44	24	1	47
7	*d*			17	0	3	75	52	22	22	50	10	1	37
8	*e*			17	57	22	76	54	18	22	55	32	1	25
9	*f*			18	54	40	77	56	18	23	0	30	1	14
10	*g*			19	51	58	78	58	23	23	5	4	1	2
11	*a*			20	49	15	80	0	31	23	9	14	0	50
12	*b*			21	46	32	81	2	42	23	13	0	0	38
13	*c*			22	43	48	82	4	56	23	16	20	0	26
14	*d*			23	41	4	83	7	12	23	19	16	0	13
15	*e*			24	38	19	84	9	30	23	21	48	0	1
16	*f*			25	35	34	85	11	50	23	23	55	0 B	12
17	*g*			26	32	48	86	14	10	23	25	37	0	25
18	*a*			27	30	2	87	16	31	23	26	54	0	38
19	*b*			28	27	15	88	18	53	23	27	47	0	50
20	*c*			29	24	28	89	21	16	23	28	15	1	3
21	*d*		♋	0	21	41	90	23	38	23	28	18	1	16
22	*e*			1	18	53	91	26	0	23	27	56	1	29
23	*f*			2	16	5	92	28	21	23	27	9	1	42
24	*g*			3	13	17	93	30	41	23	25	58	1	55
25	*a*			4	10	29	94	33	0	23	24	22	2	7
26	*b*			5	7	41	95	35	16	23	22	21	2	20
27	*c*			6	4	52	96	37	30	23	19	56	2	32
28	*d*			7	2	3	97	39	42	23	17	6	2	44
29	*e*			7	59	14	98	41	51	23	13	52	2	56
30	*f*			8	56	26	99	43	57	23	10	13	3	8

D.	Semi Diam. ☉		Hourly Mot.			Tranſ. Mer.		☉ Diſt. from Earth.
	′	″	′	″		′	″	Miles.
1	15	52	2	23	5	2	16	82.310950
11	15	50	2	23	2	2	17	82.301670
21	15	50	2	23	0	2	18	82.255940

July.

Month-day.	*Sunday* Lett.		☉'s Place.				Right Aſcenſion.			Declination.			Clocks bef. ☉.	
			S.	*D.*	*M.*	*S.*	*D.*	*M.*	*S.*	*D.*	*M.*	*S.*	*M.*	*S.*
1	*g*		♋	9	53	37	100	45	59	23	6	10	3 B	20
2	*a*			10	50	48	101	47	57	23	1	42	3	31
3	*b*			11	47	59	102	49	51	22	56	50	3	42
4	*c*			12	45	10	103	51	41	22	51	35	3	53
5	*d*			13	42	22	104	53	26	22	45	56	4	3
6	*e*			14	39	33	105	55	4	22	39	53	4	13
7	*f*			15	36	45	106	56	37	22	33	26	4	23
8	*g*			16	33	57	107	58	5	22	26	35	4	32
9	*a*			17	31	10	108	59	28	22	19	21	4	41
10	*b*			18	28	22	110	0	44	22	11	45	4	50
11	*c*			19	25	35	111	1	54	22	3	46	4	58
12	*d*			20	22	48	112	2	58	21	55	24	5	5
13	*e*			21	20	2	113	3	55	21	46	39	5	13
14	*f*			22	17	17	114	4	45	21	37	32	5	19
15	*g*			23	14	32	115	5	27	21	28	3	5	26
16	*a*			24	11	47	116	6	0	21	18	12	5	31
17	*b*			25	9	2	117	6	26	21	8	0	5	36
18	*c*			26	6	18	118	6	44	20	57	26	5	41
19	*d*			27	3	34	119	6	54	20	46	31	5	45
20	*e*			28	0	51	120	6	56	20	35	14	5	49
21	*f*			28	58	9	121	6	50	20	23	37	5	52
22	*g*			29	55	28	122	6	36	20	11	39	5	54
23	*a*		♌	0	52	47	123	6	12	19	59	20	5	56
24	*b*			1	50	7	124	5	40	19	46	42	5	57
25	*c*			2	47	28	125	5	0	19	33	44	5	58
26	*d*			3	44	49	126	4	11	19	20	27	5	58
27	*e*			4	42	11	127	3	12	19	6	50	5	58
28	*f*			5	39	35	128	2	5	18	52	54	5	57
29	g			6	36	59	129	0	49	18	38	39	5	55
30	*a*			7	34	24	129	59	23	18	24	6	5	53
31	*b*			8	31	50	130	57	49	18	9	15	5	50

D.	Semi Diam. ☉		Hourly Mot.			Tranſ. Mer.		☉ Diſt. from Earth.
	′	″	′	″		′	″	Miles.
1	15	50	2	23	0	2	17	82.369710
11	15	50	2	23	0	2	16	82.346220
21	15	51	2	23	2	2	15	82.283850

AUGUST.

Month-day.	*Sunday* Lett.	⊙'s Place.				Right Aſcenſion.			Declination.			Clocks bef. ⊙.	
		S.	*D.*	M.	*S.*	*D.*	*M.*	*S.*	*D.*	*M.*	*S.*	*M.*	*S.*
1	*c*	♌	9	29	17	131	56	5	17	54	7	5 B	47
2	*d*		10	26	45	132	54	13	17	38	41	5	43
3	*e*		11	24	13	133	52	11	17	22	58	5	38
4	*f*		12	21	42	134	49	59	17	6	58	5	33
5	*g*		13	19	12	135	47	39	16	50	41	5	27
6	*a*		14	16	44	136	45	11	16	34	7	5	20
7	*b*		15	14	17	137	42	34	16	17	17	5	13
8	*c*		16	11	52	138	39	48	16	0	11	5	6
9	*d*		17	9	28	139	36	54	15	42	50	4	58
10	*e*		18	7	4	140	33	51	15	25	14	4	49
11	*f*		19	4	42	141	30	39	15	7	23	4	40
12	*g*		20	2	22	142	27	19	14	49	17	4	30
13	*a*		21	0	2	143	23	50	14	30	57	4	19
14	*b*		21	57	44	144	20	13	14	12	24	4	8
15	*c*		22	55	27	145	16	29	13	53	37	3	57
16	*d*		23	53	12	146	12	37	13	34	37	3	45
17	*e*		24	50	58	147	8	38	13	15	24	3	32
18	*f*		25	48	45	148	4	31	12	55	58	3	19
19	*g*		26	46	33	149	0	15	12	36	19	3	6
20	*a*		27	44	23	149	55	52	12	16	2[illegible]	2	52
21	*b*		28	42	15	150	51	23	11	56	26	2	37
22	*c*		29	40	9	151	46	48	11	36	13	2	22
23	*d*	♍	0	38	4	152	42	6	11	15	48	2	7
24	*e*		1	36	1	153	37	18	10	55	13	1	51
25	*f*		2	33	58	154	32	22	10	34	28	1	35
26	*g*		3	31	57	155	27	21	10	13	32	1	19
27	*a*		4	29	58	156	22	14	9	52	26	1	2
28	*b*		5	28	1	157	17	2	9	31	11	0	44
29	*c*		6	26	5	158	11	44	9	9	46	0	27
30	*d*		7	24	11	159	6	21	8	48	13	0	9
31	*e*		8	22	19	160	0	54	8	26	30	0 A	10

D.	Semi Diam. ⊙		Hourly Mot.			Tranſ. Mer.		⊙ Diſt. from Earth
	′	″	′	″		′	″	Miles.
1	15	53	2	23	7	2	13	82.138860
11	15	54	2	23	2	2	12	82.034370
21	15	56	2	24	8	2	10	81.867510

SEPTEMBER.

Month-day.	Sunday Lett.		☉'s Place.				Right Aſcenſion.			Declination.			Clocks after ☉.	
			S.	D.	M.	S.	D.	M.	S.	D.	M.	S.	M.	S.
1	*f*		♍	9	20	29	160	55	22	8	4	39	0 A	28
2	*g*			10	18	40	161	49	46	7	42	42	0	47
3	*a*			11	16	53	162	44	6	7	20	38	1	6
4	*b*			12	15	9	163	38	23	6	58	25	1	26
5	*c*			13	13	26	164	32	37	6	36	5	1	46
6	*d*			14	11	44	165	26	46	6	13	39	2	6
7	*e*			15	10	4	166	20	52	5	51	7	2	26
8	*f*			16	8	26	167	14	55	5	28	29	2	46
9	*g*			17	6	50	168	8	57	5	5	45	3	6
10	*a*			18	5	16	169	2	57	4	42	56	3	27
11	*b*			19	3	44	169	56	54	4	20	2	3	47
12	*c*			20	2	14	170	50	50	3	57	4	4	8
13	*d*			21	0	45	171	44	44	3	34	2	4	29
14	*e*			22	59	18	172	38	37	3	10	55	4	50
15	*f*			22	57	53	173	32	30	2	47	45	5	11
16	*g*			23	56	30	174	26	23	2	24	32	5	32
17	*a*			24	55	10	175	20	17	2	1	16	5	53
18	*b*			25	53	52	176	14	11	1	37	58	6	14
19	*c*			26	52	35	177	8	4	1	14	37	6	35
20	*d*			27	51	20	178	1	58	0	51	15	6	56
21	*e*			28	50	8	178	55	54	0	27	51	7	16
22	*f*			29	48	57	179	49	52	0	4	25	7	37
										South.				
23	*g*		♎	0	47	49	180	43	52	0	19	2	7	58
24	*a*			1	46	43	181	37	53	0	42	30	8	18
25	*b*			2	45	38	182	31	56	1	5	57	8	38
26	*c*			3	44	35	183	26	2	1	29	24	8	58
27	*d*			4	43	35	184	20	12	1	52	50	9	18
28	*e*			5	42	37	185	14	26	2	16	5	9	38
29	*f*			6	41	41	186	8	43	2	39	40	9	57
30	*g*			7	40	47	187	3	3	3	3	4	10	16

D.	Semi Diam. ☉		Hourly Mot.			Tranſ. Mer.		☉ Diſt. from Earth.
	′	″	′	″		′	″	Miles.
1	15	58	2	25	4	2	9	81.655290
11	16	1	2	26	2	2	8	81.440640
21	16	3	2	27	0	2	9	81.212220

Oc-

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OCTOBER.

Month-day.	Sunday Lett.		☉ Place.				Right Aſcenſion.			Declination.			Clocks after ☉.	
			S.	D.	M.	S.	D.	M.	S.	D.	M.	S.	M.	S.
1	*a*		♎	8	39	55	187	57	28	3	26	25	10 A	35
2	*b*			9	39	5	188	51	57	3	49	43	10	54
3	*c*			10	38	17	189	46	31	4	12	59	11	12
4	*d*			11	37	31	190	41	10	4	36	12	11	30
5	*e*			12	36	47	191	35	55	4	59	22	11	47
6	*f*			13	36	5	192	30	45	5	22	28	12	4
7	*g*			14	35	25	193	25	41	5	45	30	12	21
8	*a*			15	34	48	194	20	44	6	8	28	12	37
9	*b*			16	34	13	195	15	55	6	31	20	12	53
10	*c*			17	33	40	196	11	12	6	54	8	13	9
11	*d*			18	33	9	197	6	36	7	16	50	13	24
12	*e*			19	32	40	198	2	8	7	39	26	13	38
13	*f*			20	32	13	198	57	48	8	1	55	13	52
14	*g*			21	31	48	199	53	35	8	24	18	14	5
15	*a*			22	31	25	200	49	31	8	46	35	14	18
16	*b*			23	31	4	201	35	35	9	8	43	14	30
17	*c*			24	30	45	202	41	48	9	30	43	14	42
18	*d*			25	30	28	203	38	10	9	52	35	14	53
19	*e*			26	30	13	204	34	42	10	14	19	15	3
20	*f*			27	30	1	205	31	25	10	35	53	15	13
21	*g*			28	29	51	206	28	17	10	57	18	15	22
22	*a*			29	29	42	207	25	19	11	18	33	15	30
23	*b*		♏	0	29	35	208	22	31	11	39	38	15	38
24	*c*			1	29	30	209	19	53	12	0	33	15	45
25	*d*			2	29	27	210	17	25	12	21	16	15	52
26	*e*			3	29	26	211	15	9	12	41	47	15	57
27	*f*			4	29	27	212	13	5	13	2	7	16	2
28	*g*			5	29	30	213	11	12	13	22	15	16	6
29	*a*			6	29	35	214	9	31	13	42	10	16	9
30	*b*			7	29	42	215	8	1	14	1	51	16	12
31	*c*			8	29	51	216	6	43	14	21	19	16	14

D.	Semi Diam. ☉		Hourly Mot.			Tranſ. Mer.		☉ Diſt. from Earth.
	′	″	′	″		′	″	Miles.
1	16	6	2	27	9	2	9	80.978130
11	16	9	2	82	7	2	10	80.743230
21	16	12	2	92	6	2	12	80.515620

NOVEMBER.

Month-day.	Sunday Lett.	☉'s Place.				Right Aſcenſion.			Declination.			Clocks after ☉.	
		S	D.	M.	S.	D.	M.	S.	D.	M.	S.	M.	S.
1	d	♏	9	30	1	217	5	36	14	40	43	16	A15
2	e		10	30	14	218	4	42	14	49	44	16	15
3	f		11	30	28	219	4	0	15	18	19	16	14
4	g		12	30	44	220	3	31	15	36	49	16	13
5	a		13	31	2	221	3	14	15	55	4	16	10
6	b		14	31	22	222	3	10	16	13	3	16	7
7	c		15	31	43	223	3	18	16	30	46	16	3
8	d		16	32	6	224	3	38	16	48	12	15	59
9	e		17	32	31	225	4	12	17	5	21	15	53
10	f		18	32	58	226	4	59	17	22	12	15	46
11	g		19	33	26	227	5	26	17	38	45	15	39
12	a		20	33	56	228	7	56	17	55	0	15	31
13	b		21	34	28	229	8	28	18	10	55	15	22
14	c		22	35	1	230	10	1	18	26	31	15	12
15	d		23	35	36	231	12	36	18	41	49	15	1
16	e		24	36	12	232	14	6	18	56	47	14	49
17	f		25	36	50	233	16	22	19	11	24	14	37
18	g		26	37	30	234	18	50	19	25	40	14	24
19	a		27	38	11	235	21	30	19	39	35	14	10
20	b		28	38	53	236	24	22	19	53	9	13	55
21	c		29	39	36	237	27	27	20	6	21	13	39
22	d	♐	0	40	21	238	30	44	20	19	11	13	22
23	e		1	41	8	239	34	13	20	31	38	13	5
24	f		2	41	56	240	37	54	20	43	42	12	47
25	g		3	42	45	241	41	45	20	55	23	12	28
26	a		4	43	35	242	45	47	21	6	41	12	9
27	b		5	44	27	243	50	1	21	17	34	11	48
28	c		6	45	30	244	54	25	21	28	3	11	27
29	d		7	46	14	245	58	59	21	38	8	11	6
30	e		8	47	10	247	3	44	21	47	48	10	43

D.	Semi Diam. ☉		Hourly Mot.			Tranſ. Mer.		☉ Diſt. from Earth.
	′	″	′	″		′	″	Miles.
1	16	14	2	30	5	2	14	80.281530
11	16	7	2	30	2	2	17	80.090370
21	16	19	2	31	8	2	19	79.926750

DE-

DECEMBER.

Month-day.	Sunday Lett.		☉'s Place.				Right Aſcenſion.			Declination.			Clocks after ☉.	
			S.	D.	M.	S.	D.	M.	S.	D.	M.	S.	M.	S.
1	*f*		♐	9	48	7	248	8	40	21	57	3	10 A	20
2	*g*			10	49	5	249	13	46	22	5	52	9	56
3	*a*			11	50	3	250	18	59	22	14	15	9	32
4	*b*			12	51	2	251	24	20	22	22	13	9	7
5	*c*			13	52	2	252	29	49	22	29	45	8	42
6	*d*			14	53	3	253	35	3	22	36	51	8	16
7	*e*			15	54	5	254	41	5	22	43	30	7	50
8	*f*			16	55	8	255	47	8	22	49	42	7	23
9	*g*			17	56	12	256	53	12	22	55	27	6	56
10	*a*			18	57	17	257	59	17	23	0	44	6	28
11	*b*			19	58	22	259	5	20	23	5	34	6	0
12	*c*			20	59	28	260	11	36	23	9	57	5	31
13	*d*			22	0	34	261	17	57	23	13	52	5	3
14	*e*			23	1	41	262	24	32	23	17	19	4	34
15	*f*			24	2	49	263	30	52	23	20	18	4	4
16	*g*			25	3	58	264	37	25	23	22	49	3	35
17	*a*			26	5	7	265	44	0	23	24	52	3	5
18	*b*			27	6	17	266	50	38	23	26	26	2	35
19	*c*			28	7	27	267	57	18	23	27	32	2	5
20	*d*			29	8	37	269	3	59	23	28	10	1	35
21	*e*		♑	0	9	48	270	10	41	23	28	20	1	5
22	*f*			1	10	59	271	17	23	23	28	1	0	35
23	*g*			2	12	10	272	24	4	23	27	14	0	4
24	*a*			3	13	21	273	30	45	23	25	59	0 B	26
25	*b*			4	14	33	274	37	25	23	24	15	0	56
26	*c*			5	15	45	275	44	3	23	22	3	1	25
27	*d*			6	16	57	276	50	38	23	19	23	1	55
28	*e*			7	18	9	277	57	11	23	16	15	2	25
29	*f*			8	19	21	279	3	41	23	12	39	2	54
30	*g*			9	20	33	240	10	7	23	8	35	3	23
31	*a*			10	21	45	281	16	29	23	4	3	3	52

D.	Semi Diam. ☉		Hourly Mot.			Tranſ. Mer.		☉ Diſt. from Earth.
	′	″	′	″		′	″	Miles.
1	16	21	2	32	4	2	21	79.794720
11	16	22	2	32	7	2	22	79.700760
21	16	23	2	32	0	2	23	79.643250

72. *A* Table, *ſhewing the Variation of the Sun's Declination, to every Hour, or* 15 *Degrees of Longitude from the Meridian of* London, *his daily Variation being known.*

Hours and Degrees of Longitude, Eaſt or Weſt, from the Meridian of London.

Daily Variat.	1 ° 15	2 ° 30	3 ° 45	4 ° 60	5 ° 75	6 ° 90	7 ° 105	8 ° 120	9 ° 135	10 ° 150	11 ° 165	12 ° 180
min.	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.
2							1	1	1	1	1	1
3					1	1	1	1	1	1	1	1
4				1	1	1	1	1	1	2	2	2
5			1	1	1	1	1	2	2	2	2	2
6			1	1	1	1	2	2	2	2	3	3
7		1	1	1	1	2	2	3	3	3	3	3
8		1	1	1	2	2	2	3	3	3	4	4
9		1	1	1	2	2	3	3	3	4	4	4
10		1	2	2	2	2	3	3	4	4	5	5
11		1	2	2	2	3	3	4	4	5	5	5
12		1	2	2	2	3	3	4	4	5	5	6
13		1	2	2	3	3	4	4	5	5	6	6
14	1	1	2	2	3	3	4	5	5	6	6	7
15	1	1	2	2	3	4	4	5	6	6	7	7
16	1	1	2	3	3	4	5	5	6	7	7	8
17	1	1	2	3	4	4	5	6	6	7	8	8
18	1	1	2	3	4	4	5	6	7	7	8	9
19	1	2	2	3	4	5	6	6	7	8	9	9
20	1	2	2	3	4	5	6	6	7	8	9	10
21	1	2	3	3	4	5	6	7	8	9	10	10
22	1	2	3	4	5	5	6	7	8	9	10	11
23	1	2	3	4	5	6	7	8	9	10	11	11
24	1	2	3	4	5	6	7	8	9	10	11	12

73. *A* Table, *ſhewing the Dip of Horizon to* 50 *Feet Height above the Surface of the Earth and Sea. Alſo the Refraction of the Atmoſphere from the Horizon to the Zenith, for the Parallel of* London *and the Torrid Zone.*

Feet.	Dip.		Alt.	R. Lond.		R. Equat.		Alt.	R. Lond		R. Equat.	
	′	″	*D.*	*M.*	*S.*	*M.*	*S.*	*D.*	*M.*	*S.*	*M.*	*S.*
1	1	8	0	33	45	27	0	41	1	2	0	51
2	1	36	1	23	7	20	31	42	1	0	0	49
3	1	58	2	17	8	15	53	43	0	58	0	48
4	2	16	3	13	20	12	25	44	0	56	0	46
5	2	33	4	10	48	10	5	45	0	54	0	44
6	2	47	5	9	2	8	18	46	0	52	0	42
7	3	0	6	7	45	7	4	47	0	50	0	41
8	3	13	7	6	47	6	5	48	0	48	0	40
9	3	24	8	6	0	5	21	49	0	47	0	39
10	3	35	9	5	22	4	50	50	0	45	0	38
12	3	56	10	4	52	4	20	51	0	44	0	36
14	4	15	11	4	27	3	54	52	0	42	0	35
16	4	33	12	4	5	3	31	53	0	40	0	33
18	4	40	13	3	47	3	14	54	0	39	0	32
20	5	5	14	3	31	2	59	55	0	38	0	31
22	5	20	15	3	17	2	47	56	0	36	0	30
24	5	34	16	3	4	2	36	57	0	35	0	29
26	5	48	17	2	53	2	26	58	0	34	0	28
28	6	1	18	2	43	2	17	59	0	32	0	27
30	6	13	19	2	34	2	10	60	0	31	0	26
32	6	25	20	2	26	2	3	61	0	30	0	25
34	6	38	21	2	18	1	57	62	0	28	0	24
36	6	49	22	2	11	1	51	63	0	27	0	23
38	7	0	23	2	5	1	45	64	0	26	0	22
40	7	11	24	1	59	1	41	65	0	25	0	21
42	7	21	25	1	54	1	36	66	0	24	0	20
44	7	33	26	1	49	1	31	67	0	23	0	19
46	7	42	27	1	44	1	27	68	0	22	0	18
48	7	52	28	1	40	1	24	69	0	31	0	17
50	8	2	29	1	36	1	20	70	0	20	0	16
			30	1	32	1	17	72	0	18	0	15
			31	1	28	1	14	74	0	16	0	13
			32	1	25	1	10	76	0	14	0	12
			33	1	22	1	8	58	0	12	0	10
			34	1	19	1	6	80	0	10	0	8
			35	1	16	1	4	82	0	8	0	6
			36	1	13	1	2	84	0	6	0	5
			37	1	11	1	0	86	0	4	0	3
			38	1	8	0	58	88	0	2	0	2
			39	1	6	0	55	90	0	0	0	0
			40	1	4	0	53					

75. A TABLE, ſhewing the Number of Days, from any Day in any Month, to the ſame Day in any other Month.

From	Jan.	Feb.	Mar.	April.	May	June.	July.	Auguſt.	Sept.	October.	Nov.	Dec.
To	Feb. 31	Mar. 28	April 31	May 30	June 31	July 30	Aug. 31	Sept. 31	Oct. 30	Nov. 31	Dec. 30	Jan. 31
	Mar. 59	April 59	May 61	June 61	July 61	Aug. 61	Sept. 62	Oct. 61	Nov. 61	Dec. 61	Jan. 61	Feb. 62
	Apr. 90	May 89	June 92	July 91	Aug. 92	Sept. 92	Oct. 92	Nov. 92	Dec. 91	Jan. 92	Feb. 92	Mar. 90
	May 120	June 120	July 122	Aug 122	Sept. 123	Oct. 122	Nov. 123	Dec. 122	Jan. 122	Feb. 123	Mar. 120	Apr. 121
	June 151	July 150	Aug. 153	Sept. 153	Oct. 153	Nov. 153	Dec. 153	Jan. 153	Feb. 153	Mar. 151	Apr. 151	May 151
	July 181	Aug. 181	Sept. 184	Oct. 183	Nov. 184	Dec. 183	Jan. 184	Feb. 184	Mar. 281	Apr. 182	May 181	June 182
	Aug. 212	Sept. 212	Oct. 214	Nov. 214	Dec. 214	Jan. 214	Feb. 215	Mar. 212	Apr. 212	May 212	June 212	July 212
	Sept. 243	Oct. 242	Nov. 245	Dec. 244	Jan. 245	Feb. 245	Mar. 243	Apr. 243	May 242	June 243	July 242	Aug. 243
	Oct. 273	Nov. 273	Dec. 275	Jan. 275	Feb. 276	Mar. 273	Apr. 274	May 273	June 273	July 273	Aug. 273	Sept. 274
	Nov 304	Dec. 303	Jan. 306	Feb. 305	Mar. 304	Apr. 304	May 304	June 304	July 303	Aug. 304	Sept. 304	Oct. 304
	Dec. 334	Jan. 334	Feb. 337	Mar. 334	Apr. 335	May 334	June 335	July 334	Aug. 334	Sept. 335	Oct. 334	Nov. 335
	Jan. 365	Feb. 365	Mar. 365	Apr. 365	May 365	June 365	July 365	Aug. 365	Sept. 365	Oct. 365	Nov. 365	Dec. 365

76. A TABLE, *ſhewing the Gregorian* Sunday *Letters for theſe Years*, viz.

Yrs.	Sunday Letters.	Yrs.	Sunday Letters.	Yrs.	Sunday Letters.
1760	F E	1801	D	1842	B
1761	D	1802	C	1843	A
1762	C	1803	B	1844	G F
1763	B	1804	A G	1845	E
1764	A G	1805	F	1846	D
1765	F	1806	E	1847	C
1766	E	1807	D	1848	B A
1767	D	1808	C B	1849	G
1768	C B	1809	A	1850	F
1769	A	1810	G	1851	E
1770	G	1811	F	1852	D C
1771	F	1812	E D	1853	B
1772	E D	1813	C	1854	A
1773	C	1814	B	1855	G
1774	B	1815	A	1856	F E
1775	A	1816	G F	1857	D
1776	G F	1817	E	1858	C
1777	E	1818	D	1859	B
1778	D	1819	C	1860	A G
1779	C	1820	B A	1861	F
1780	B A	1821	G	1862	E
1781	G	1822	F	1863	D
1782	F	1823	E	1864	C B
1783	E	1824	D C	1865	A
1784	D C	1825	B	1866	G
1785	B	1826	A	1867	F
1786	A	1827	G	1868	E D
1787	G	1828	F E	1869	C
1788	F E	1829	D	1870	B
1789	D	1830	C	1871	A
1790	C	1831	B	1872	G F
1791	B	1832	A G	1873	E
1792	A G	1833	F	1874	D
1793	F	1834	E	1875	C
1794	E	1835	D	1876	B A
1795	D	1836	C B	1877	G
1796	C B	1837	A	1878	F
1797	A	1838	G	1879	E
1798	G	1839	F	1880	D C
1799	F	1840	E D	1881	B
1800	E	1841	C	1882	A

77. A TABLE *of the fixed Holy-days, and remarkable Days throughout the Year.*

JANUARY, xxxi Days.

1 *Circumciſion*
4 Sir Iſaac Newt bo. 1642, N S.
5 Old Chriſtmas Day
6 *Twelfth-Day*, or Epiphany
8 Lucian, Anno 307
10 Princeſs Elizabeth born 1740
13 Hillary, 357
15 Exchequer opens
18 Priſca, 45
20 Fabian, 353. Oct. Hill. 1 ret.
21 Agnes, 304
22 Vincent, 304
23 Hillary Term begins
25 *Converſion of St. Paul*
27 Quind. Hill. 2 Return
30 *K. Cha. I. Mart.* 1648-9, *O. S.*

FEBRUARY, xxviii Days.

2 *Purif.* or Cand. Day
3 Blaize. 3 Return
5 Agatha, 252
9 Oct. Purif. 4 r.
12 Hillary Term ends
13 Old Candlemas Day
13 Valentine, 45
24 *Matthias*
28 Hare-hunting goes out.

MARCH, xxxi Days.

1 David
2 Chad.
5 Prſs. Mary of Heſſe born 1722.
7 Perpet. Maur. 252
12 Gregory, 604
17 St. Patrick
18 Edward King of Weſt Saxony
19 Prſſe Louiſa Ann b. 1749. Joſeph Cuthbert. Day and Night equal
21 Benedict, 542
25 *Annunciation*, Pr. Edward born 1739. 1ſt Quarter Day.

APRIL, xxx Days.

1 All Fools Day
3 Rich. B. of Chich. 1218
4 Ambroſe
5 Old Lady Day
19 Alphege, 1006
23 St. George
25 *St. Mark*
26 Duke of Cumberland. b. 1721
27 Victory of Cul. 1746.

MAY, xxxi Days.

1 *Philip and James*
3 Invention of the Croſs
6 St. John ante Port. Lat. 98
19 Dunſtan, 988
24 Prince Fred. William b. 1750
26 Auguſtine, 596. 1 Return
27 Ven. Bede, 673
29 *King Charles* II. *Nat. & Reſtor.*

JUNE, xxx Days.

1 Nicom. 41
4 Geo. Prince Wales born 1738
5 Boniface, 725
10 Princeſs Amelia born 1711
11 *Barnabas*, 50
17 St. Alban
20 Tranſ. of Edward K. of W. Sax.
22 King George II. Inaug.
24 *Nat. St. John Bapt.* 2 Quar. Day
29 *St. Peter*, 68
30 Buck-hunting comes in, and continues till Holy Rood.

JULY, xxxi Days.

2 Viſitation of the Virgin Mary
3 Dies Comitior
4 Tranſ. St. Mart.
5 Old Midſummer Day
7 Tho. a Becket

15 *Swithin*, 862
20 Marg. 243
22 Mary Magdalen, 84. Prſs. Carolina and Matilda b. 1751, Magdalen College Election.
25 *St. James*, 42
26 Ann
30 Dog Days begin.

AUGUST, xxxi Days.

1 Lammas Day
6 Transfiguration
7 Name of Jeſus
10 St. Laurence, 259
11 Princeſs Auguſta born 1737
15 Aſſumption
21 Athanaſius
24 *St. Bartholomew*, 73
28 Auſtin, 432
29 Beheading of St. John Baptiſt.

SEPTEMBER, xxx Days.

1 Giles, 750
2 London burnt 1666, O. S.
7 Enurchus, 374
Dog Days end
8 Nat. of the bleſſed Virgin Mary
14 Exal. of the Croſs
17 Lambert, 733
21 *St Matthew*, 90
22 Equal Day and Night
26 Cyprian, 288
28 Sheriff of London ſworn
29 *St. Michael.* 3d Quarter Day. Hare-hunting comes in, and laſts till the End of February
30, Jerom, 420.

OCTOBER, xxxi Days.

1 Remigius, 544
6 St. Faith, 290
9 St. Dennis
10 Old Michaelmas
13 Tranſ. of K. Ed. Conf. 1165
15 Etheldred V.
18 *St. Luke*
22 King George II. crowned, 1727
25 Criſpin
28 *St. Simon and Jude*, 64.

NOVEMBER, xxx Days.

1 *All Saints*
2 All Souls
Election at all Souls Col. Oxen
3 Cras. anim. 1 Return
5 Gunpowder Treaſ. 1605, O. S.
6 Leonard, 456, Michaelma. Term begins
7 Prince Henry Frederick, born 1745
8 Ld Mayor ſworn at Weſtminſter
9 King George II. born 1683, N. S. Birth-Day kept the 10th, Lord Mayor's Feaſt-day, London
11 St. Martin, 397
12 Cras Mart. 2 Return
13 Britius, 412
15 Machutus, 500
17 Hugh, 1200
19 Octab. Mart. 3 Return
20 Edmund, 871
22 Cicilia, 225, Old Michaelmas Day
23 Clem. 92
25 Prince William Henry, born 1743
Quid. Mart. 4 Ret. Catherine
28 Michaelmas Term ends
30 *St. Andrew*
Princeſs Dowager of Wales, b. 1719.

DECEMBER, xxxi Days.

4 Barbary
6 Nicholas, 342
8 Concept. bleſſed Virgin Mary
13 Lucy
16 O Sapientia
21 *St. Thomas*, 35
Shorteſt Day
25 *Chriſtmas-Day.* 4 Quarter-Day Fox-hunting comes in, and laſts till Lady-day
26 *St. Stephen*
27 *St. John* the Evangeliſt
28 *Holy Innocents*
31 Sylveſter, Conf. 335.

78. A TABLE *of New and Full Moons.*

Anno 1760.	*Anno* 1762.	*Anno* 1764.	*Anno* 1766.
F. *Jan.* 2 4 A.	F. *Jan.* 11 10 M.	N. *Jan.* 3 10 M.	N. *Jan.* 11 1 M.
N. *Jan.* 18 6 M.	N. *Jan.* 25 4 M.	F. *Jan.* 19 1 M.	F. *Jan.* 26 1 M.
F. *Feb.* 1 6 M.	F. *Feb.* 8 8 A.	N. *Feb.* 2 1 M.	N. *Feb.* 9 Noon.
N. *Feb.* 16 8 A.	N. *Feb.* 23 11 A.	F. *Feb.* 17 1 A.	F. *Feb.* 24 7 A.
F. *Mar.* 1 9 A.	F. *Mar.* 10 7 M	N. *Mar.* 2 5 A.	N. *Mar.* 10 10 A.
N. *Mar.* 17 8 M	N. *Mar.* 25 4 A.	F. *Mar.* 17 Midn.	F. *Mar.* 26 11 M.
F. *Mar.* 31 1 M.	F. *Apr.* 8 5 A.	N. *Apr.* 1 10 M.	N. *Apr.* 9 10 M.
N. *Apr.* 15 5 A.	N. *Apr.* 24 6 M.	F. *Apr.* 16 9 M.	F. *Apr.* 24 Midn.
F. *Apr.* 30 6 M.	F. *May* 8 4 M	N. *May* 1 3 A.	N. *May* 8 11 A.
N. *May* 15 1 M.	N. *May* 23 4 A	F. *May* 15 5 A.	F. *May* 24 10 M.
F. *May* 29 9 A.	F. *June* 6 5 A.	N. *May* 30 7 A.	N. *June* 7 Noon.
N. *June* 13 8 M.	N. *June* 22 1 M	F. *June* 13 Midn	F. *June* 22 5 A.
F. *June* 28 Noon	F. *July* 6 5 A.	N. *June* 29 9 M.	N. *July* 7 2 M.
N. *July* 12 3 A.	N. *July* 20 8 A.	F. *July* 13 9 M.	F. *July* 22 1 M.
F. *July* 28 1 M.	F. *Aug.* 4 8 A.	N. *July* 28 9 A.	N. *Aug.* 5 6 A.
N. *Aug.* 11 1 M.	N. *Aug.* 19 4 A.	F. *Aug.* 11 6 A.	F. *Aug.* 20 7 M.
F. *Aug.* 26 1 A.	F. *Sept.* 3 Noon	N. *Aug.* 27 7 M.	N. *Sept.* 4 9 M.
N. *Sept.* 9 Noon.	N. *Sept.* 17 Midn.	F. *Sept.* 10 7 M.	F. *Sept.* 18 3 A.
F. *Sept.* 25 1 M.	F. *Oct.* 3 4 M.	N. *Sept.* 25 5 A.	N. *Oct.* 4 1 M.
N. *Oct.* 9 2 M.	N. *Oct.* 17 9 M.	F. *Oct.* 9 10 A.	F. *Oct.* 18 2 M.
F. *Oct.* 24 11 M.	F. *Nov.* 1 8 A.	N. *Oct.* 25 2 M.	N. *Nov.* 2 4 A.
N. *Nov.* 7 7 A.	N. *Nov.* 15 9 A.	F. *Nov.* 8 4 A.	F. *Nov* 16 3 A.
F. *Nov.* 22 9 A.	F. *Nov.* 31 11 M.	N. *Nov.* 23 1 A.	N. *Dec.* 2 5 M.
N. *Dec.* 7 1 A.	N. *Dec.* 15 11 M.	F. *Dec.* 8 Noon	F. *Dec.* 16 6 M.
F. *Dec.* 22 7 M.	F. *Dec.* 31 Midn	N. *Dec.* 22 11 A.	N. *Dec.* 31 5 A.
Anno 1761.	*Anno* 1763.	*Anno* 1765.	*Anno* 1767.
N. *Jan.* 6 9 M.	N. *Jan.* 14 4 M.	F. *Jan.* 7 6 M.	F. *Jan.* 15 1 M.
F. *Jan.* 20 6 A.	F. *Jan.* 29 Noon.	N. *Jan.* 21 11 M.	N. *Jan.* 30 3 M.
N. *Feb.* 5 3 M.	N. *Feb.* 12 10 A.	F. *Feb.* 5 11 A.	F. *Feb.* 13 8 A.
F. *Feb.* 19 6 M	F. *Feb.* 27 11 A.	N. *Feb.* 19 11 A.	N. *Feb.* 28 1 A.
N. *Mar.* 6 7 A.	N. *Mar.* 14 5 A.	F. *Mar.* 7 1 A.	F. *Mar.* 15 3 A.
F. *Mar.* 20 7 A.	F. *Mar.* 29 8 M	N. *Mar.* 21 1 A.	N. *Mar.* 29 9 A.
N. *Apr.* 5 8 M.	N. *Apr.* 13 10 M.	F. *Apr.* 6 1 M.	F. *Apr.* 14 7 M.
F. *Apr.* 19 8 M.	F. *Apr.* 27 4 A.	N. *Apr.* 20 4 M.	N. *Apr.* 29 9 M.
N. *May* 4 6 A.	N. *May* 13 1 M.	F. *May* 5 10 M	F. *May* 13 9 A.
F. *May* 18 11 A	F. *May* 27 1 M.	N. *May* 19 8 A.	N. *May* 27 7 A.
N. *June* 3 1 M.	N. *June* 11 2 A	F. *June* 3 5 A	F. *June* 12 8 M.
F. *June* 17 1 A	F. *June* 25 11 M.	N. *June* 18 11 M.	N. *June* 26 7 M.
N. *July* 2 8 M.	N. *July* 10 Midn.	F. *July* 2 Midn	F. *July* 11 5 A.
F. *July* 17 4 M.	F. *July* 24 11 A.	N. *July* 18 2 M.	N. *July* 25 8 A.
N. *July* 31 3 A.	N. *Aug.* 9 8 M	F. *Aug.* 1 7 M.	F. *Aug.* 10 11 M.
F. *Aug.* 15 7 A.	F. *Aug.* 23 1 A	N. *Aug.* 16 4 A.	N. *Aug.* 24 Noon.
N. *Aug.* 28 11 A.	N. *Sept.* 7 5 A.	F. *Aug.* 30 4 A.	F. *Sept.* 8 10 M.
F. *Sept.* 14 10 M.	F. *Sept.* 22 5 M.	N. *Sept.* 15 4 M.	N. *Sept.* 23 4 M.
N. *Sept.* 28 10 M.	N. *Oct.* 7 1 M.	F. *Sept.* 29 3 M.	F. *Oct.* 7 4 A.
F. *Oct.* 13 11 A.	F. *Oct.* 21 10 A.	N. *Oct.* 14 5 A.	N. *Oct.* 22 9 A.
N. *Oct.* 27 10 A	N. *Nov* 5 10 M.	F. *Oct.* 28 6 A.	F. *Nov.* 6 2 M.
F. *Nov.* 12 11 M.	F. *Nov.* 21 4 A.	N. *Nov.* 13 4 M.	N. *Nov.* 21 1 A.
N. *Nov.* 26 2 A.	N. *Dec.* 4 9 A.	F. *Nov.* 27 11 M	F. *Dec.* 5 2 A.
F. *Dec.* 11 11 A.	F. *Dec.* 20 9 M.	N. *Dec.* 12 3 A	N. *Dec.* 21 4 M.
N. *Dec.* 26 8 M.		F. *Dec.* 27 1 M.	

79. *A* Table, *ſhewing how many Hours and Minutes the Moon is paſt the Meridian, when it is high Water at the following Places,* viz.

	H.	M.
Aberdeen	0	45
St. Andrews	2	15
Amſterdam	3	0
Armentiers	3	0
Abroth	5	15
Antwerp	6	0
Archangel	6	0
Abermorich	6	0
Amazon river	6	0
Aldborough	9	45
Beach	0	0
Bajador (Barbary)	0	0
Blacktail Beacon	0	15
Blackneſs	1	30
Bell Iſle	1	30
Berwick	1	30
Bluet without	2	15
Britain ſouth coaſt	3	0
Biſcay coaſt	3	0
Bourdeaux river	3	0
Buchaneſs	3	0
Bona Eſperance	3	0
Breſt	3	45
Baſs without	3	45
Bridlington	3	45
Bourdeaux R. within	3	45
Brovage without	3	45
Baltimore	4	30
Bree-ſound	4	30
Blackney	6	0
Briſtol	6	0
Briſtol-key	6	45
Bridgwater	7	30
Cape Blanco	9	45
Bulloign	10	30
C. Cautin (Barbary)	0	0
Calice without	1	30
Camfere	1	30
Coquet	3	0
Cork in Ireland	4	30
Cape-clear, Ireland	4	30
Caldy	5	15
Carnarven-bay	5	15
Cromer	6	0
Caſkets without	8	15
C. Sierre-lion Guiney	8	15
Chamberneſs	9	45
Cows	10	10
Caen in the Foſs	10	30
Calice-road	10	30
Calſhot	11	15
Dunkirk	0	0
Dover-port	0	0
Port Deſire, America	0	0
Downs	1	30
Dundee	2	15
Denby	2	15
Dort	3	0
Dunbar	4	30
Dungarven	4	30
Dartmouth	5	15
St. David's-head	6	0
Dublin, Ireland	8	15
Diep	9	45

	H.	M.
Dunwick	0	45
Dover	10	30
Elder	0	0
Elve	0	0
Enchuyſen	0	0
Edam	1	30
Edinburgh	4	30
Egmon	4	30
Exwater	7	36
Entrance of the Emes	7	30
Fluſhing	0	45
Finmark-coaſt	1	30
Fountnay without	2	75
Flamborough-head	3	0
Fair Iſle	3	0
Frith	3	30
Falmouth	4	30
Foy	5	15
Foulneſs	6	45
Frieſland-coaſt	7	30
Florida, Carolina	7	30
Foreland N. and S.	9	45
Gibraltar-road	0	0
Guernſey	0	45
Goree	1	0
Graveſend	1	30
Gaſcoin	3	0
Groy	3	0
Gorend	11	15
Hever	0	0
Hern	0	0
Holy Iſland	1	30
Hartlepool	3	0
Humber without	4	30
Hull	6	0
Hamborough	6	0

	H.	M.
Hague	8	15
Harwich	10	30
St. Helens	10	30
Jutland Iſles	0	0
Ireland W. coaſt	3	0
Ireland ſouth coaſt	5	15
John de Luce	10	30
Kentiſh Knock	0	0
Killiars	3	0
Kinſale, Ireland	4	30
Kilduyn	7	30
Liſbon	2	15
St. Lucas	2	15
London	3	0
Leith	4	30
Lawreneſs	4	30
Lyn without	5	15
Lundey	5	15
Lyn	6	0
Lanion	6	45
Landſend	7	30
Lam-bay	8	15
Leoſtaff	9	45
Lenow	9	45
Maxe within	0	45
Malden	0	45
St. Mark	2	15
St. Matthew point	3	45
Mount's-bay	4	30
Milford	5	15
Moonleſs	5	15
St. Maloes	5	15
Magnes-ſound	8	15
Iſle of Man	9	0
Marget-road	11	15
Newport (Iſle-wight)	0	0

	H.	M.		H.	M.
Nore weſt-end	0	0	Shetland	3	0
North C. Maggero	3	0	Scilly	3	45
Nantz-river without	3	0	Scarborough	3	45
Newcaſtle	5	15	Sound	3	45
St. Nicholas, Ruſſia	6	45	Severn	4	30
Normandy coaſt	10	30	Stockton	5	15
Orkneys	3	0	Spurn	5	15
Orwel	9	0	Start	6	45
Orfordneſs	9	45	Seyn-head	10	30
Portſmouth	0	0	Senegal	10	30
Poictou S. coaſt	3	0	Terveer within	0	45
Pens	3	0	Thanet	1	30
Porthus	3	0	Terveer without	1	30
Portugal coaſt	3	0	Tinmouth	3	0
Plymouth	6	0	Tees-mouth	3	0
St. Powls	6	0	Tenariff	3	0
Podeſemſk, Ruſſia	6	45	Torbay	5	15
Portland	8	15	Texel	7	30
Peterport	8	15	Ureck	0	0
Picardy coaſt	10	30	Uſe	3	0
Quinborough	0	0	Uſhant without	6	0
Quebec Canada	6	0	Iſle of Wight	0	0
Rebdan	0	45	Winchelſea	0	45
Rocheſter	0	45	Weilands	1	30
Rumney	1	30	Whitby	3	0
Ramkins	1	30	Waterford in Ireland	4	30
Rotterdam	3	0	Weymouth	6	0
Roan	3	45	Wells	6	0
Rochell without	3	45	Weymouth-key	6	45
Roan-river within	3	45	Wieringham	7	0
Ramſey	5	15	Winterton	9	0
Rye	11	15	Youghall (Ireland)	4	30
Rhodes	11	15	Yarmouth-road	8	15
Sheerneſs	0	0	Yarmouth-peer	9	0
Southampton	3	0	Yarmouth-town	9	45
Spits	0	0	Zealand coaſt	1	30

80. *A* TABLE, *ſhewing the Right Aſcenſions, Declinations and Magnitudes of the fixed Stars, calculated for the Year* 1760.

The Names of the STARS.	Bay. Ch.	R. Aſcen.			Declination.			Magn.
		h.	m.	ſ.	d.	m.	ſ.	
The Southern Star in Andromeda's Girdle, Mirach.	β	0	55	55	34	17	45 N	2
The bright one in her left Foot, Almaack.	γ	1	49	4	41	7	46 N	2 3
The unformed Star above the Ram's Head.	α	1	53	24	22	16	55 N	2
In the Head of Meduſa, Algol.	β	2	52	17	39	58	52 N	2 3
In Perſeus's right Side, Algenib.	α	3	6	58	48	58	52 N	2 3
The middle and brighteſt of the 7 Stars.	η	3	33	0	23	19	12 N	3
The Bull's South Eye, Aldebaran.	α	4	21	53	15	59	30 N	1
In the left Shoulder of Auriga Capella.	α	4	58	36	45	44	9 N	1
The left Foot of Orion, Rigel.	β	5	2	50	8	30	23 S	1
The middle Star in his Girdle.		5	23	49	1	22	57 S	2
In his right Shoulder, Betelgeuſe.	α	5	41	55	7	20	22 N	1
In the great Dog's Mouth, Sirius.	α	6	34	28	16	21	59 S	1
In the Head of the 1ſt Twin, Caſtor and Apollo.	α	7	18	57	32	24	35 N	1
In the leſſer Dog's Thigh, Procyon.	α	7	26	32	5	51	30 N	2
In the Head of the 2d Twin, Pollux or Hercules.	β	7	30	22	28	36	23 N	2
Hydra's Heart, Alphard.	α	9	15	35	7	35	52 S	2
The Lion's Heart, Regulus.	α	9	55	21	13	9	38 N	1
In the Extremity of his Tail, Deneb.	β	11	36	38	15	56	50 N	1 2
In the Virgin's right Wing, Vindemiatrix.	ε	12	50	4	12	17	1 N	3
In her left Hand, Ariſta.	α	13	12	22	9	52	1 S	1
Betw. the Thighs of Bootes, Arcturus.	α	14	4	37	20	30	52 N	1
In the Southern Scale of Libra.	α	14	37	29	15	0	5 S	2
In the Northern Scale of Libra.	β	15	3	37	8	27	39 S	2
The bright Star in the Northern Crown.	α	15	24	25	27	33	44 N	2 3
The Scorpion's Heart, Antares.	α	16	14	28	25	51	41 S	1
In the Head of Serpentarius.	α	17	23	35	12	45	0 N	2
Bright Star in the Harp, Lyra.	α	18	28	40	38	33	44 N	1
Bright Star in the Eagle, Altair.	α	19	38	48	8	13	24 N	1 2
In the Mouth of the Southern Fiſh, Fomalhat.	—	22	44	0	30	55	9 S	2 1
In the Wing of Pegaſus, Markab.	α	22	52	34	13	52	8 N	2

81. *A* TABLE, *ſhewing how many Hours and Minutes of Time, are equal to any Number of Degrees of Right Aſcenſion.*

D. R. Aſ.	Time.		D. R. Aſ.	Time.		D. R. Aſ.	Time.	
	H.	M.		H.	M.		H.	M.
1	0	4	31	2	4	70	4	40
2	0	8	32	2	8	80	5	20
3	0	12	33	2	12	90	6	0
4	0	16	34	2	16	100	6	40
5	0	20	35	2	20	110	7	20
6	0	24	36	2	24	120	8	0
7	0	28	37	2	28	130	8	40
8	0	32	38	2	32	140	9	20
1	0	36	39	2	36	150	10	0
10	0	40	40	2	40	160	10	40
11	0	44	41	2	44	170	11	20
12	0	48	42	2	48	180	12	0
13	0	52	43	2	52	190	12	40
14	0	56	44	2	56	200	13	20
15	1	0	45	3	0	210	14	0
16	1	4	46	3	4	220	14	40
17	1	8	47	3	8	230	15	20
18	1	12	48	3	12	240	16	0
19	1	16	49	3	16	250	16	40
20	1	20	50	3	20	260	17	20
21	1	24	51	3	24	270	18	0
22	1	28	52	3	28	280	18	40
23	1	32	53	3	32	290	19	20
24	1	36	54	3	36	300	20	0
25	1	40	55	3	40	310	20	40
26	1	44	56	3	44	320	21	20
27	1	48	57	3	48	330	22	0
28	1	52	58	3	52	340	22	40
29	1	56	39	3	56	350	23	20
30	2	0	60	4	0	360	24	0

82. *A* Table, *ſhewing how many Degrees of Right Aſcenſion, are equal to any Number of Hours or Minutes in Time.*

Hours.	Deg.	Min. of a Deg.	Time.		Min. of a Deg.	Time.	
			'	"		'	"
1	15	1	0	15	31	7	45
2	30	2	0	30	32	8	0
3	45	3	0	45	33	8	15
4	60	4	1	0	34	8	30
5	75	5	1	15	35	8	45
6	90	6	1	30	36	9	0
7	105	7	1	45	37	9	15
8	120	8	2	0	38	9	30
9	135	9	2	15	39	9	45
10	150	10	2	30	40	10	0
11	165	11	2	45	41	10	15
12	180	12	3	0	42	10	30
13	195	13	3	15	43	10	45
14	210	14	3	30	44	11	0
15	225	15	3	45	45	11	15
16	240	16	4	0	46	11	30
17	255	17	4	15	47	11	45
18	270	18	4	30	48	12	0
19	285	19	4	45	49	12	15
20	300	20	5	0	50	12	30
21	315	21	5	15	51	12	45
22	330	22	5	30	52	13	0
23	345	23	5	45	53	13	15
24	360	24	6	0	54	13	30
		25	6	15	55	13	45
		26	6	30	56	14	0
		27	6	45	57	14	15
		28	7	0	58	14	30
		29	7	15	59	14	45
		30	7	30	60	14	0

83. *A* Table, *ſhewing the Sun's Right Aſcenſion and Declination for the three firſt Signs,* ♈, ♉, ♊.

Note, For ♋, ♌, ♍, ſubtract the Right Aſcenſion from 12 Hours,
For ♎, ♏, ♐, add to the Right Aſcenſion 12 Hours,
For ♑, ♒, ♓, ſubtract the Right Aſcenſion from 24 Hours.

	One Sign.				Two Signs.				Three Signs.			
	R. Aſc.		Declin.		R. Aſc.		Declin.		R. Aſc.		Declin.	
	H.	M.	°	′	H.	M.	°	′	H.	M.	°	′
1	0	4	0	24	1	55	11	50	3	55	20	23
2	0	7	0	48	1	59	12	11	4	0	20	36
3	0	11	1	11	2	3	12	32	4	4	20	47
4	0	15	1	35	2	7	12	52	4	8	20	59
5	0	18	1	59	2	11	13	12	4	12	21	10
6	0	20	2	23	2	15	13	32	4	16	21	20
7	0	26	2	47	2	19	13	52	4	21	21	31
8	0	29	3	10	2	23	14	21	4	25	21	40
9	0	33	3	34	2	26	14	31	4	29	21	50
10	0	37	3	58	2	30	14	50	4	33	21	59
11	0	40	4	21	2	34	15	9	4	38	22	8
12	0	44	4	45	2	38	15	27	4	42	22	16
13	0	48	5	8	2	42	15	46	4	46	22	24
14	0	52	5	32	2	46	16	4	4	51	22	31
15	0	55	5	55	2	50	16	21	4	55	22	38
16	0	59	6	18	2	54	16	39	4	59	22	44
17	1	3	6	41	2	58	16	56	5	3	22	50
18	1	6	7	4	3	2	17	13	5	8	22	56
19	1	10	7	27	3	6	17	30	5	12	23	1
20	1	14	7	50	3	10	17	46	5	16	23	6
21	1	18	8	12	3	14	18	2	5	21	23	10
22	1	21	8	35	3	18	18	18	5	25	23	14
23	1	26	8	57	3	22	18	30	5	29	23	17
24	1	29	9	19	3	26	18	48	5	34	23	20
25	1	33	9	41	3	30	19	3	5	38	23	23
26	1	36	10	3	3	35	19	17	5	43	23	25
27	1	40	10	25	3	39	19	31	5	47	23	26
28	1	44	10	46	3	43	19	45	5	51	23	27
29	1	48	11	8	3	47	19	51	5	56	23	28
30	1	52	11	29	3	51	20	11	6	0	23	28⅓

84. *A* TABLE, *ſhewing the Latitudes and Difference of Meridians from the Royal Obſervatory at* Greenwich, *of the following Places*, viz.

NAMES OF PLACES.	Dif. Mer.				Alt. of Pole.			
	h.	m.	ſ.		d.	m.	ſ.	
Alexandria in Egypt	2	1	6	A.	31	7	0	N.
Athens in Greece	1	35	30	A.	38	5	0	N.
Babylon in Egypt, Grand Cairo	2	5	45	A.	30	2	30	N.
Berlin in Brandenburg	0	53	50	A.	52	33	0	N.
Cape of Good Hope in Africa	1	8	0	A.	34	15	0	N.
Cadiz in Spain	0	24	28	S.	36	33	30	N.
Carthagena in America	5	0	46	S.	10	26	0	N.
Copenhagen in Denmark	0	51	0	A.	55	40	45	N.
Dantzick in Poland	1	15	12	A.	54	22	0	N.
Iſland of St. Helena	0	24	0	S.	15	55	0	S.
Jeruſalem	2	21	20	A.	31	55	0	N.
London at St. Paul's	0	0	20	S.	51	30	40	N.
Liſbon in Portugal	0	36	50	S.	38	42	30	N.
Moſcow in Ruſſia	2	41	20	A.	55	36	0	N.
Naples in Italy	0	58	40	A.	40	50	45	N.
Obſervatory at Greenwich	0	0	0	—	51	28	30	N.
Obſervatory at Paris	0	9	20	A.	48	50	10	N.
Oxford	0	5	4	S.	51	45	0	N.
Peterſburg in Ruſſia	2	1	20	A.	60	0	0	N.
Pekin in China	7	45	20	A.	39	54	0	N.
Porto Bello in America	5	19	20	S.	9	33	5	N.
Prague in Bohemia	0	59	0	A.	40	4	30	N.
Rome, the Metropolis of Italy	0	50	0	A.	41	54	0	N.
Rochelle in France	0	5	4	S.	46	9	53	N.
Smyrna in Turkey	1	49	19	A.	38	28	7	N.
Teneriff Mountain	1	6	12	S.	28	23	27	N.
Terra del Gada in Madagaſcar	2	58	0	A.	19	29	0	S.
Tornea in Lapland	1	35	15	A.	65	50	50	N.
Venice in Italy	0	48	18	A.	45	25	0	N.
Vienna in Auſtria	1	5	30	A.	48	12	48	N.
Upſal in Sweden	1	11	0	A.	59	51	50	N.

85. *A* Table *of* Horizontal Diſtances *for Horizontal Dials, ſhewing alſo the Diſtance of each* Hour-line *from the* Meridian *upon* direct North *or* South *Planes; calculated to every Degree of* Latitude.

An Horizontal Dial, Latitude.	Hours. XI. I.		Hours. X. II.		Hours. IX. III.		Hours. VIII. IV.		Hours. VII. V.		Hours. VI.		A direct South Dial, Latitude.
	d.	m.	d.	m.	d.	m.	d.	m.	d.	m.	d.	m.	
0	0	0	0	0	0	0	0	0	0	0	0	00	90
1	0	16	0	34	1	0	1	44	3	44	90	00	89
2	0	32	1	9	2	0	3	27	7	25	90	00	88
3	0	48	1	44	3	0	5	11	11	3	90	00	87
4	1	5	2	19	4	0	6	54	14	36	90	00	86
5	1	20	2	52	4	58	8	35	18	1	90	00	85
6	1	36	3	27	5	58	10	16	21	19	90	00	84
7	2	52	4	3	6	57	11	55	24	27	90	00	83
8	2	8	4	37	7	55	13	33	27	23	90	00	82
9	2	23	5	9	8	54	15	10	30	17	90	00	81
10	2	40	5	43	9	51	16	44	32	57	90	00	70
11	2	55	6	17	10	48	18	17	35	27	90	00	79
12	3	11	6	51	11	45	19	48	37	49	90	00	78
13	3	27	7	24	12	41	21	17	40	1	90	00	77
14	3	53	7	57	13	36	22	44	42	4	90	00	76
15	3	58	8	30	14	31	24	9	44	0	90	00	75
16	4	13	9	2	15	25	25	31	45	49	90	00	74
17	4	29	9	35	16	26	26	52	47	26	90	00	73
18	4	44	10	8	17	10	28	9	49	5	90	00	72
19	4	59	10	39	18	2	29	25	50	33	90	00	71
20	5	14	11	10	18	53	30	39	51	55	90	00	60
21	5	29	11	41	19	44	31	50	53	9	90	00	69
22	5	44	12	10	20	32	32	58	54	21	90	00	68
23	5	59	12	43	21	20	34	5	55	30	90	00	67
24	6	13	13	13	22	8	35	10	56	37	90	00	66
25	6	28	13	43	22	55	36	12	57	34	90	00	65
26	6	42	14	12	23	40	37	13	58	34	90	00	64

A

A TABLE *of* Horizontal Distances, *&c.*

An Horizontal Dial, Latitude.	Hours. XI. I.		Hours. X. II.		Hours. IX. III.		Hours. VIII. IV.		Hours. VII. V.		Hours. VI.		*A direct South Dial, Latitude.*
	d.	m.	d.	m.	d.	m.	d.	m.	d.	m.	d.	m.	
27	6	56	14	41	24	25	38	11	59	27	90	00	63
28	7	10	15	10	25	9	39	7	60	17	90	00	62
29	7	24	15	40	25	52	40	2	61	4	90	00	61
30	7	58	16	6	26	33	40	54	61	49	90	00	60
31	7	50	16	34	27	15	41	44	62	30	90	00	59
32	8	5	17	1	27	55	42	30	63	11	90	00	58
33	8	19	17	27	28	34	43	20	63	49	90	00	57
34	8	31	17	54	29	13	44	5	64	24	90	00	56
35	8	44	18	20	29	50	44	49	64	58	90	00	55
36	8	57	18	45	30	27	45	31	65	30	90	00	54
37	9	10	19	9	31	2	46	12	66	10	90	00	53
38	9	22	19	34	31	37	46	50	66	29	90	00	52
39	9	34	19	58	32	11	47	28	66	56	90	00	51
40	9	45	20	21	32	44	48	7	67	21	90	00	50
41	9	57	20	44	33	16	48	39	67	47	90	00	49
42	10	10	21	7	33	46	49	12	68	11	90	00	48
43	10	22	21	29	34	18	49	44	68	33	90	00	47
44	10	32	21	51	34	47	50	10	68	54	90	00	46
45	10	43	22	12	35	17	50	46	69	15	90	00	45
46	10	54	22	23	35	44	51	15	69	35	90	00	44
47	11	5	22	53	36	11	51	42	69	53	90	00	43
48	11	17	23	13	36	37	52	9	70	11	90	00	42
49	11	25	23	33	37	3	52	35	70	28	90	00	41
50	11	35	23	52	37	28	53	00	70	43	90	00	40
51	11	45	24	9	37	52	53	24	70	59	90	00	39
52	11	55	24	27	38	15	53	46	71	13	90	00	38
53	12	5	24	43	38	37	54	18	71	28	90	00	37
54	12	13	25	2	38	58	54	29	71	41	90	00	36
55	12	22	25	18	39	19	54	49	71	54	90	00	35
56	12	32	25	34	39	40	55	9	72	5	90	00	34
57	12	40	25	50	39	59	55	28	72	17	90	00	33
58	12	48	26	5	40	81	55	45	72	28	90	00	32

A TABLE *of* Horizontal Diſtances, *&c.*

An Horizontal Dial, Latitude.	Hours.		Hours.		Hours.		Hours.		Hours.		Hours.		*A direct South Dial, Latitude.*
	XI.	I.	X.	II.	IX.	III.	VIII.	IV.	VII.	V.	VI.		
	d.	m.	d.	m.	d.	m.	d.	m.	d.	m.	d.	m.	
59	12	46	26	20	40	36	56	3	72	38	90	00	31
60	13	4	26	34	40	54	56	19	72	48	30	00	30
61	13	11	26	47	41	10	56	34	72	58	90	00	29
62	13	19	27	1	41	21	56	49	73	7	90	00	28
63	13	26	27	13	41	42	57	3	73	15	90	00	27
64	13	32	27	25	41	57	57	17	73	24	90	00	26
65	13	39	27	37	32	15	57	30	73	32	90	00	25
66	13	46	27	49	42	25	57	43	73	39	90	00	24
67	13	51	27	59	42	38	57	54	73	46	90	00	23
68	13	57	27	9	42	50	58	5	73	53	90	00	22
69	14	3	28	19	43	2	58	16	73	59	90	00	21
70	14	8	28	29	43	13	58	26	74	05	90	00	20
71	14	13	28	27	43	18	58	35	74	11	90	00	19
72	14	18	28	46	43	24	58	44	74	16	90	00	18
73	14	22	28	54	43	36	58	52	74	20	90	00	17
74	14	27	28	2	43	52	59	00	74	25	90	00	16
75	14	30	29	17	44	00	59	7	74	30	90	00	15
76	14	33	29	15	44	8	59	15	74	34	90	00	14
77	14	37	29	21	44	14	59	22	74	37	90	00	13
78	14	41	29	27	44	22	59	27	74	41	90	00	12
79	14	44	29	32	44	28	59	32	74	44	90	00	11
80	14	47	29	37	44	34	59	37	74	45	90	00	10
81	14	49	29	41	44	37	59	40	74	49	90	00	9
82	14	51	29	45	44	40	59	44	74	51	90	00	8
83	14	53	29	49	44	44	59	47	73	53	90	00	7
84	14	55	29	52	44	48	59	51	74	55	90	00	6
85	14	56	29	54	44	53	59	54	74	57	90	00	5
86	14	57	29	55	44	55	59	55	74	58	90	00	4
87	14	58	29	56	45	56	59	56	74	58	90	00	3
88	14	59	29	57	44	57	59	58	74	59	90	00	2
89	14	59	29	58	44	58	59	59	74	59	90	00	1
90	15	00	30	00	45	00	60	00	75	00	90	00	0

86. *A* TABLE *of Angles which every Rhomb (or Point of the Compaſs) makes with the Meridian.*

NORTH.	*SOUTH.*	*Point.*	*D.*	*M.*	*NORTH.*	*SOUTH.*
			02	49		
			05	37		
			08	26		
N. by Eaſt.	S. by Eaſt.	1	11	15	N. by Weſt.	S. by W.
			14	04		
			16	52		
			19	41		
N. N. E.	S. S. E.	2	22	30	N. N. W.	S. S. W.
			25	19		
			28	07		
			30	56		
N. E. by N.	S. E. by S.	3	33	45	N. W. by W.	S. W. by S.
			36	34		
			39	22		
			42	11		
North-Eaſt.	South-Ea.	4	45	00	Nor. Weſt.	Sou. Weſt.
			47	49		
			50	37		
			53	26		
N. E. by E.	S. E. by E.	5	56	15	N. W. by W.	S. W. by W.
			59	04		
			61	52		
			64	41		
E. N. E.	E. S. E.	6	67	30	W. N. W.	W. S. W.
			70	19		
			73	07		
			75	56		
E. by N.	E. by S.	7	78	45	W. by N.	W. by S.
			81	34		
			84	22		
			87	11		
Eaſt.	Eaſt.	8	90	00	Weſt.	Weſt.

87. *A* TABLE, *ſhewing what Declination the Sun muſt have, when the Day is any Number of whole Hours longer or ſhorter than* 12 *Hours in any Latitude.*

Lat.	Diff. 1 H. ⊙ Decli.		Diff. 2 H. ⊙ Decli.		Diff. 3 H. ⊙ Decli.		Diff. 4 H. ⊙ Decli.		Diff. 5 H ⊙ Decli.		Diff. 6 H. ⊙ Decli.	
	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.
89	0	8	0	16	0	23	0	30	0	36	0	43
88	0	16	0	31	0	46	1	00	1	13	1	25
87	0	23	0	47	1	9	1	30	1	50	2	07
86	0	32	1	2	1	56	2	00	2	27	2	50
85	0	39	1	18	1	55	2	3	3	03	3	32
84	0	47	1	27	2	18	3	00	3	39	4	14
83	0	55	1	37	2	42	3	31	4	15	4	56
82	1	3	1	46	3	05	4	01	4	52	5	39
81	1	11	1	55	3	29	4	32	5	29	6	22
80	1	19	2	37	3	52	5	03	6	07	7	06
79	1	27	2	47	4	16	5	34	6	45	7	48
78	1	35	3	07	4	40	6	05	7	22	8	31
77	1	43	3	16	5	04	6	36	8	00	9	14
76	1	51	3	37	5	28	7	07	8	38	9	57
75	1	59	3	58	5	51	7	38	9	16	10	40
74	2	8	4	15	6	16	8	10	9	54	11	25
73	2	17	4	32	6	41	8	43	10	33	12	10
72	2	26	4	49	7	06	9	15	11	12	12	56
71	2	36	5	6	7	32	9	47	11	51	13	42
70	2	43	5	23	7	56	10	19	12	30	14	26
69	2	52	5	51	8	22	10	52	13	05	15	11
68	3	1	5	59	8	49	11	26	13	41	15	57
67	3	10	6	17	9	15	11	59	14	16	16	43
66	3	19	6	35	9	42	12	33	14	52	17	29
65	3	29	6	53	10	07	13	07	15	28	18	15
64	3	38	7	12	10	35	13	43	16	15	19	02
63	3	48	7	40	11	04	14	19	17	02	19	49
62	3	57	7	59	11	32	14	55	17	49	20	37
61	4	8	8	19	12	01	15	31	18	36	21	25
60	4	17	8	30	12	28	16	06	19	23	22	12
59	4	28	8	51	12	58	16	44	20	07	23	02
58	4	39	9	12	13	29	17	23	20	51	23	50
57	4	52	9	33	13	59	18	01	21	36		
56	5	1	9	54	14	30	18	40	22	21		
55	5	83	10	17	15	00	19	18	23	05		

A TABLE, *ſhewing what Declination the Sun muſt have, &c*

Lat.	Diff. 1 H.		Diff. 2 H.		Diff. 3 H.		Diff. 4 H.		Diff. 5 H.		Diff. 6 H.	
	☉ Decli.		☉ Decli.		☉ Decli.		☉ Decli.		☉ Decli.		☉ Decli.	
	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.
54	5	25	10	40	15	33	19	59	24	02		
53	5	38	11	04	16	07	20	40				
52	5	50	11	27	16	40	21	22				
51	6	02	11	51	17	14	22	04				
50	6	15	12	15	17	48	22	45				
49	6	30	12	42	18	26	23	27				
48	6	42	13	09	19	03	24	09				
47	6	56	13	37	19	40						
46	7	17	14	04	20	18						
45	7	26	14	31	20	57						
44	7	43	15	02	21	40						
43	8	00	15	33	22	23						
42	8	17	16	04	23	06						
41	8	34	16	36	23	23						
40	8	50	17	09								
39	9	10	17	47								
38	9	29	18	24								
37	9	49	19	02								
36	10	12	19	39								
35	10	34	20	17								
34	11	00	21	09								
33	11	26	22	01								
32	11	52	22	53								
31	12	18	23	44								
30	12	44										
29	13	15										
28	13	48										
27	14	22										
26	14	57										
25	15	39										
24	16	20										
23	17	05										
22	17	54										
21	18	46										
20	19	44										
19	20	46										
18	21	53										
17	23	07										
16	24	26										

To know what Declination the Sun muſt have when the Day is a given Numbers of Hours long in a given Latitude; firſt, take the Difference between the given Length of the Day and 12 Hours, find this Difference at the Top of the Table, under which, in the ſame Column, oppoſite to the Latitude of the Place, is the Declination required.

88. *A* TRAVERSE-TABLE.

Distance.	$\frac{1}{4}$ Point		$\frac{1}{2}$ Point.		$\frac{3}{4}$ Point.		1 Point.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
1	1 0	0 0	1 0	0 1	1 0	0 1	1 0	0 2
2	2 0	0 0	2 0	0 2	2 0	0 3	2 0	0 4
3	3 0	0 0	3 0	0 3	3 0	0 4	3 9	0 6
4	4 0	0 2	4 0	0 4	4 0	0 6	3 9	0 8
5	5 0	0 2	5 0	0 5	4 9	0 7	4 9	1 0
6	6 0	0 3	6 0	0 6	5 9	0 9	5 9	1 2
7	7 0	0 3	7 0	0 7	6 9	1 0	6 9	1 4
8	8 0	0 4	8 0	0 8	7 9	1 2	7 8	1 6
9	9 0	0 4	9 0	0 9	8 9	1 3	8 8	1 8
10	10 0	0 5	9 9	1 0	9 9	1 5	9 8	1 9
15	15 0	0 7	14 9	1 5	14 8	2 2	14 7	2 9
20	20 0	1 0	19 9	2 0	19 8	2 9	19 6	3 9
25	25 0	1 2	24 9	2 4	24 7	3 7	24 5	4 9
30	30 0	1 5	29 8	2 9	29 7	4 4	29 4	5 8
35	34 9	1 7	34 8	3 4	34 6	5 1	31 3	6 8
40	39 9	2 0	39 8	3 9	39 6	5 9	39 2	7 8
45	44 9	2 2	44 8	4 4	44 5	6 6	44 1	8 8
50	49 9	2 4	49 8	4 9	49 5	7 3	49 0	9 8
55	54 9	2 7	54 7	5 4	54 4	8 1	53 9	10 7
60	59 9	2 9	59 7	5 9	59 3	8 8	58 8	11 7
70	69 9	3 4	69 7	6 9	69 2	10 3	68 7	13 7
80	79 9	3 9	79 6	7 8	79 1	11 7	78 5	15 6
90	89 9	4 4	89 6	8 8	89 0	13 2	88 3	17 6
100	99 9	4 9	99 5	9 8	98 9	14 7	98 1	19 5
200	199 8	9 8	199 0	19 6	197 3	29 4	196 2	39 0
300	299 7	14 7	298 5	29 4	296 7	44 1	294 3	58 5
400	399 6	19 6	398 0	39 2	295 6	58 8	392 4	78 0
500	499 5	24 5	497 5	49 0	494 5	73 5	490 5	97 5
Distan.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	7 $\frac{3}{4}$ Point		7 $\frac{1}{2}$ Point.		7 $\frac{1}{4}$ Point.		7 Point.	

A TRAVERSE TABLE.

Diſtance.	1 ¼ Point.		1 ½ Point.		1 ¾ Point.		2 Points.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
1	1 0	0 2	1 0	0 3	0 9	0 3	0 9	0 4
2	1 9	0 5	1 9	0 6	1 9	0 7	1 8	0 8
3	2 9	0 7	2 9	0 9	2 8	1 0	2 8	1 1
4	3 9	1 0	3 8	1 3	3 8	1 4	3 7	1 5
5	4 8	1 2	4 8	1 5	4 7	1 7	4 6	1 9
6	5 8	1 5	5 8	1 7	5 6	2 0	5 5	2 3
7	6 8	1 7	6 7	2 0	6 6	2 4	6 4	2 7
8	7 8	1 9	7 7	2 3	7 5	2 7	7 4	3 1
9	8 7	2 2	8 6	2 6	8 5	3 0	8 3	3 4
10	9 7	2 4	9 6	2 9	9 4	3 4	9 2	3 8
15	14 5	3 6	14 4	4 4	14 1	5 1	13 9	5 7
20	19 4	4 9	19 1	5 8	18 9	6 7	18 5	7 6
25	24 2	6 5	23 9	7 3	23 5	8 4	23 1	9 6
30	29 1	7 3	28 7	8 7	28 2	10 1	27 7	11 5
35	33 9	8 5	33 5	10 2	33 0	11 8	32 3	13 4
40	38 8	9 7	38 3	11 6	37 7	13 5	36 9	15 3
45	43 6	10 9	43 1	13 1	42 4	15 2	41 6	17 2
50	48 5	12 1	47 8	14 5	47 1	16 8	46 2	19 1
55	53 3	13 4	52 6	16 0	51 8	18 5	50 8	21 0
60	58 2	14 6	57 4	17 4	56 5	20 2	55 4	23 0
70	67 9	17 0	67 0	20 3	65 9	23 6	64 7	26 8
80	77 6	19 4	76 6	23 2	75 3	26 9	73 9	30 6
90	87 3	21 9	86 1	26 1	84 7	30 3	83 1	34 4
100	97 0	24 3	95 7	29 0	94 2	33 7	92 4	38 3
200	194 0	48 6	191 4	58 0	188 4	67 4	184 8	76 6
300	291 0	72 9	287 1	87 0	282 6	101 1	277 2	114 9
400	388 0	97 2	382 8	116 0	376 8	134 8	369 6	155 2
500	485 0	121 5	478 5	145 0	471 0	168 5	462 0	191 5
Diſtan.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	6 ¾ Point.		6 ½ Point.		6 ¼ Point.		6 Points.	

A TRAVERSE TABLE.

Diſtance.	2 ¼ Point.		2 ½ Point.		2 ¾ Point.		3 Points.	
	Lat	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
1	0 9	0 4	0 9	0 5	0 9	0 5	0 8	0 6
2	1 8	0 9	1 8	0 9	1 7	1 0	1 7	1 1
3	2 7	1 2	2 6	1 4	2 6	1 5	2 5	1 7
4	3 6	1 7	3 5	1 9	3 3	2 1	3 3	2 2
5	4 5	2 1	4 4	2 4	4 2	2 6	4 2	2 8
6	5 4	2 6	5 3	2 8	5 0	3 1	5 0	3 3
7	6 3	3 0	6 2	3 3	6 8	3 6	5 8	3 9
8	7 2	3 4	7 1	3 8	6 6	4 1	6 6	4 4
9	8 1	3 8	7 9	4 2	7 5	4 6	7 5	5 0
10	9 0	4 3	8 8	4 7	8 3	5 1	8 3	5 6
15	13 6	6 4	13 2	7 1	12 5	7 7	12 5	8 3
20	18 1	8 5	17 6	9 4	17 6	10 3	16 6	11 1
25	22 6	10 7	22 0	11 8	21 7	12 8	20 7	13 9
30	27 1	12 8	26 5	14 1	25 7	15 1	24 9	16 7
35	31 6	15 0	30 9	16 5	30 0	18 0	29 1	19 4
40	36 2	17 1	35 3	18 9	34 3	20 6	33 3	22 2
45	40 7	19 2	39 7	21 2	38 6	23 1	37 4	25 0
50	45 2	21 4	44 1	23 6	40 9	25 7	41 6	27 8
55	49 7	23 5	48 5	25 9	47 2	28 3	45 7	30 6
60	54 2	25 9	52 9	28 3	51 5	30 8	49 9	33 3
70	63 3	29 6	61 7	33 0	60 0	36 0	58 2	38 9
80	72 3	34 2	70 5	37 7	68 6	41 1	66 5	44 4
90	81 4	38 5	79 4	42 5	77 2	46 3	74 8	50 0
100	99 4	42 7	88 2	47 1	85 7	51 3	83 1	55 6
200	180 8	85 4	176 4	94 2	171 4	102 6	166 2	111 2
300	271 2	128 1	264 6	141 3	257 1	153 9	249 3	166 8
400	361 6	170 8	352 8	188 4	342 8	205 2	332 4	222 4
500	452 0	213 5	441 0	235 5	428 5	256 5	415 5	278 0
Diſtan.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	5 ¾ Point.		5 ½ Point.		5 ¼ Point.		5 Points.	

A

A TRAVERSE TABLE.

Distance.	3 ¼ Point.		3 ½ Point.		3 ¾ Point.		4 Points.	
	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.
1	0 8	0 0	0 8	0 6	0 7	0 7	0 7	0 7
2	1 0	1 2	1 5	1 3	1 5	1 3	1 4	1 4
3	2 4	1 8	2 3	1 9	2 2	2 0	2 1	2 1
4	3 2	2 9	3 1	2 5	3 0	2 7	2 8	2 8
5	4 0	3 0	3 0	3 2	3 7	3 4	3 5	3 5
6	4 8	3 6	4 6	3 8	4 4	4 0	4 2	4 2
7	5 6	4 2	5 4	4 4	4 2	4 7	4 9	4 9
8	6 4	4 8	6 2	5 1	5 9	5 4	5 7	5 7
9	7 2	5 4	7 0	2 7	6 7	6 0	6 4	6 4
10	8 0	6 0	7 7	6 3	7 4	6 7	7 1	7 1
15	12 0	8 9	11 6	9 5	11 1	10 1	10 6	10 6
20	16 1	11 9	15 5	12 7	14 8	13 4	14 1	14 1
25	20 1	14 9	19 3	15 9	18 5	16 8	17 7	17 7
30	24 1	17 9	23 2	19 0	22 2	20 1	21 2	21 2
35	28 1	20 8	27 0	22 2	25 9	23 5	24 7	24 7
40	32 1	23 8	30 9	25 4	29 6	26 9	28 3	28 3
45	36 1	26 8	34 8	28 5	33 3	30 2	31 8	31 8
50	40 2	29 8	38 6	31 7	37 0	33 6	35 3	35 3
55	44 2	32 8	42 5	34 9	40 7	36 9	38 9	38 9
60	48 3	35 7	46 4	38 1	44 5	40 3	42 4	42 4
70	56 2	41 7	54 1	44 4	51 9	47 0	49 5	49 5
80	64 3	47 7	61 8	51 7	59 3	53 7	56 6	56 6
90	72 3	53 6	69 6	57 1	66 7	60 4	63 6	63 6
100	80 3	59 6	77 3	63 4	74 1	67 2	70 7	70 7
200	160 6	119 2	154 6	126 8	148 2	134 4	141 4	141 4
300	240 9	178 8	231 9	190 2	222 3	201 6	212 1	212 1
400	321 2	238 4	309 2	253 6	296 4	268 8	282 3	232 8
500	401 5	298 0	386 5	317 0	370 5	336 0	353 5	353 5
Distan.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.	Dep.	Lat.
	4 ¾ Point		4 ½ Point.		4 ¼ Point.		4 Points.	

89. 4

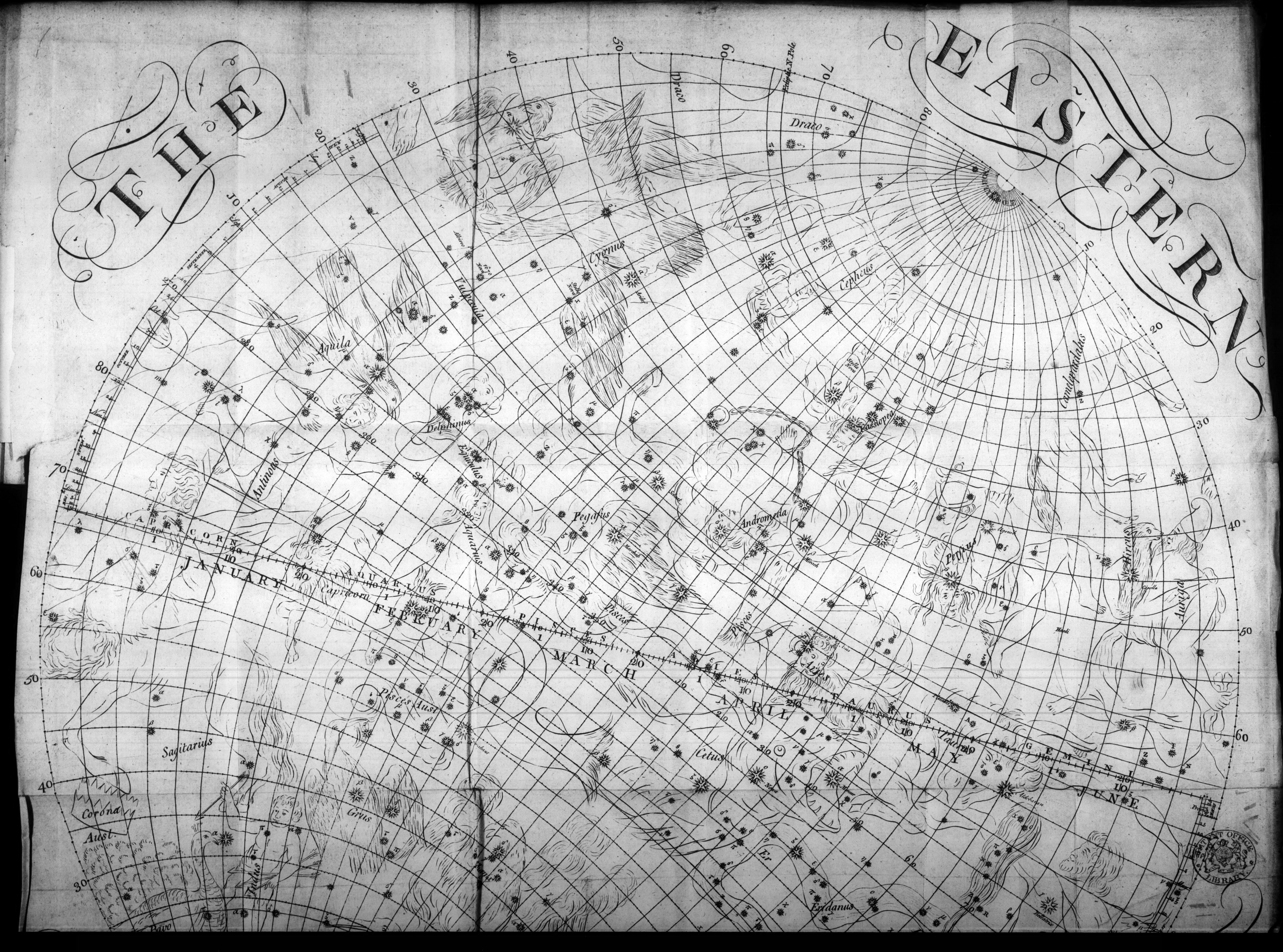
89. *A* TABLE, *ſhewing the Comets Nodes, their Perihelia, and Log. of their Perihelion Diſtances from the Sun; the Radius of the Earth's Orbit being* 1, &c.

Yrs.	Nodes.		Per.		Diſt. a ☉ Log.		Motions.
	S.	°	S.	°			
1337	2	24	1	8	9	609	Retrog.
1472	9	11	1	15	9	734	R.
1531	1	19	10	1	9	753	R.
1532	2	20	3	21	9	706	Direct.
1556	5	25	9	9	9	666	D.
1557	0	25	4	9	9	263	R.
1580	0	18	3	19	9	775	D.
1585	1	7	0	9	10	038	R.
1590	5	15	7	7	9	760	R.
1593	5	14	5	26	8	950	D.
1596	12	12	7	18	9	710	R.
1607	1	20	10	2	9	768	R.
1618	2	16	0	2	9	580	D.
1652	2	28	0	28	9	928	D.
1661	2	22	3	26	9	651	D.
1664	2	21	4	11	10	011	R.
1665	7	18	2	12	9	027	R.
1672	9	27	1	17	9	843	D.
1677	7	26	4	17	9	448	R.
1680	9	2	8	22	7	787	D.
1682	1	21	10	3	9	765	R.
1683	5	23	2	25	9	748	R.
1684	8	28	7	29	9	982	D.
1686	11	20	2	17	9	511	D.
1698	8	27	9	1	9	839	R.
1699	4	21	7	2	9	871	R.
1702	6	9	4	19	9	810	D.
1706	0	13	2	12	9	629	D.
1707	1	22	2	20	9	934	D.
1718	4	8	4	1	10	011	R.
1723	0	14	1	13	10	000	R.
1729	10	10	10	23	10	629	D.
1737	7	16	10	26	9	348	D.
1739	0	27	3	12	9	828	R.
1742	6	5	7	7	9	884	R.
1743	2	18	3	3	9	921	D.
1744	1	15	6	17	9	347	D.
1747	10	27	9	7	10	342	R.
1748	7	22	7	5	9	924	R.

Note, If a Comet of any Year has its Node, Perihelion, Perihelion Diſtance from the Sun, and Motion, nearly agreeing with another Comet of another Year, it is probable that they are one and the ſame, and therefore may be expected to return again, after the ſame Interval of Time.

Thus have I introduced among the aforegoing Tables, ſuch as are abſolutely neceſſary in every Treatiſe of the Globes themſelves, in order to come to any nice Determination by them, notwithſtanding which all ſuch Treatiſes are ſilent on this Head, as if thoſe Inſtruments wanted no ſuch Correction, whereas nothing is more certain than that if the Globe be conſtructed ever ſo truly, the Days of the Month muſt be fixed for ſome particular Year, and toward the End of every four Years, it ſhews the Sun's Place erroneous by a Degree very nearly, and all the other Particulars depending thereon proportionably falſe. And therefore our Planiſpheres muſt have been ſubject to the ſame Errors, had we not ſubſtituted theſe Tables, not of Neceſſity, but as a neceſſary Supplement for uſing both of theſe Inſtruments in an exact Manner; the Conſtructions, Properties and Uſes of which, will be readily underſtood by ſuch as ſhall have duly conſidered the aforegoing geographical and aſtronomical Definitions, and are tolerably well verſed in the Doctrine of the Sphere. Wherefore we ſhall not here exemplify the Uſes of theſe Tables, ſeeing they appear at Sight, but proceed to ſuch Particulars as may be moſt neceſſary to be obſerved in this Work. And here it is to be noted, that as the Projection of our Univerſal Planiſpheres is on the Plane of the Meridian after the ſtereographic Manner, the Eye being ſuppoſed to be placed in the Superficies of the Sphere, at the equinoctial Points, *Aries* and *Libra*; ſo the Peculiarity of our Invention conſiſts wholly in the Diſcovery of a tranſparent *Slider*, *Index* or *Projector*, capable of forming inſtantaneouſly, of Arches circular, all Kinds of ſpherical Triangles, ſuch as are uſually drawn by Scale and Compaſſes, in the Science of ſpherical Geometry. This *Slider*, *Index* or *Projector* may be rendered tranſparent a great Variety of Ways, the beſt that have occurred to us, and whereby, alſo, ſhould the Tranſparency be loſt, it may be ſoon reſtored, is as follows.

Take a Spoonful of Nut-oil, Linſeed-oil, or Sweet-oil, and make it warm over the Fire. Place the Slider, on a ſmooth clean Table, or with a Sheet of clean Paper under to keep off the Duſt. Dip a ſoft Bruſh, clean Feather, clean Linnen Cloth, or your Finger into the Oil, and oil the Slider over on both Sides, until no whitiſh Spots be ſeen. If too much Oil be laid on, wipe it off with a clean Linnen Cloth. Then warm the Slider well before the Fire, and ſet it aſide, either between two Sheets of clean ſoft Paper, or without, until it is dry.



THE EASTERN

PATENT OFFICE LIBRARY

PLANISPHERE OF THE HEAVENS

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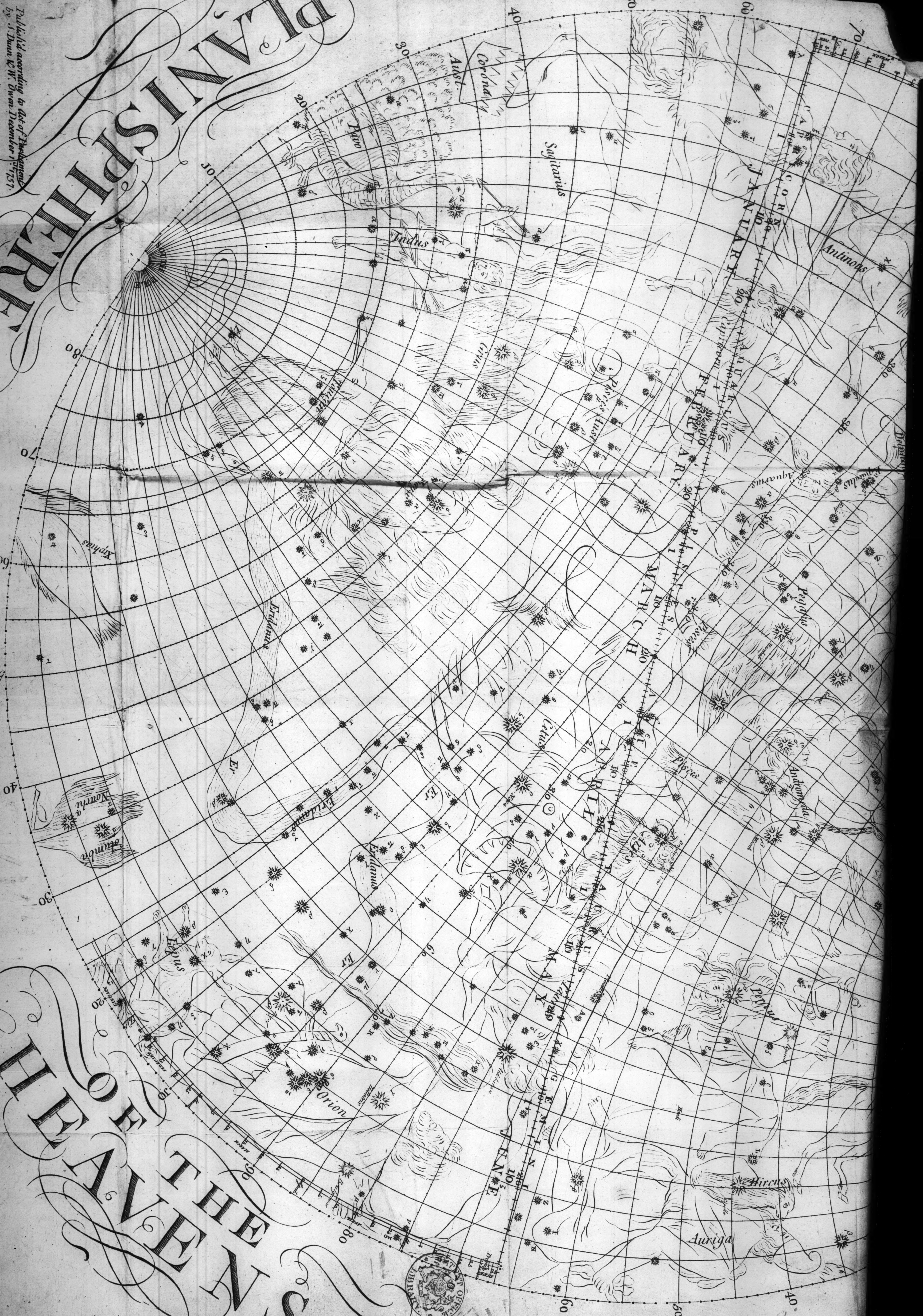

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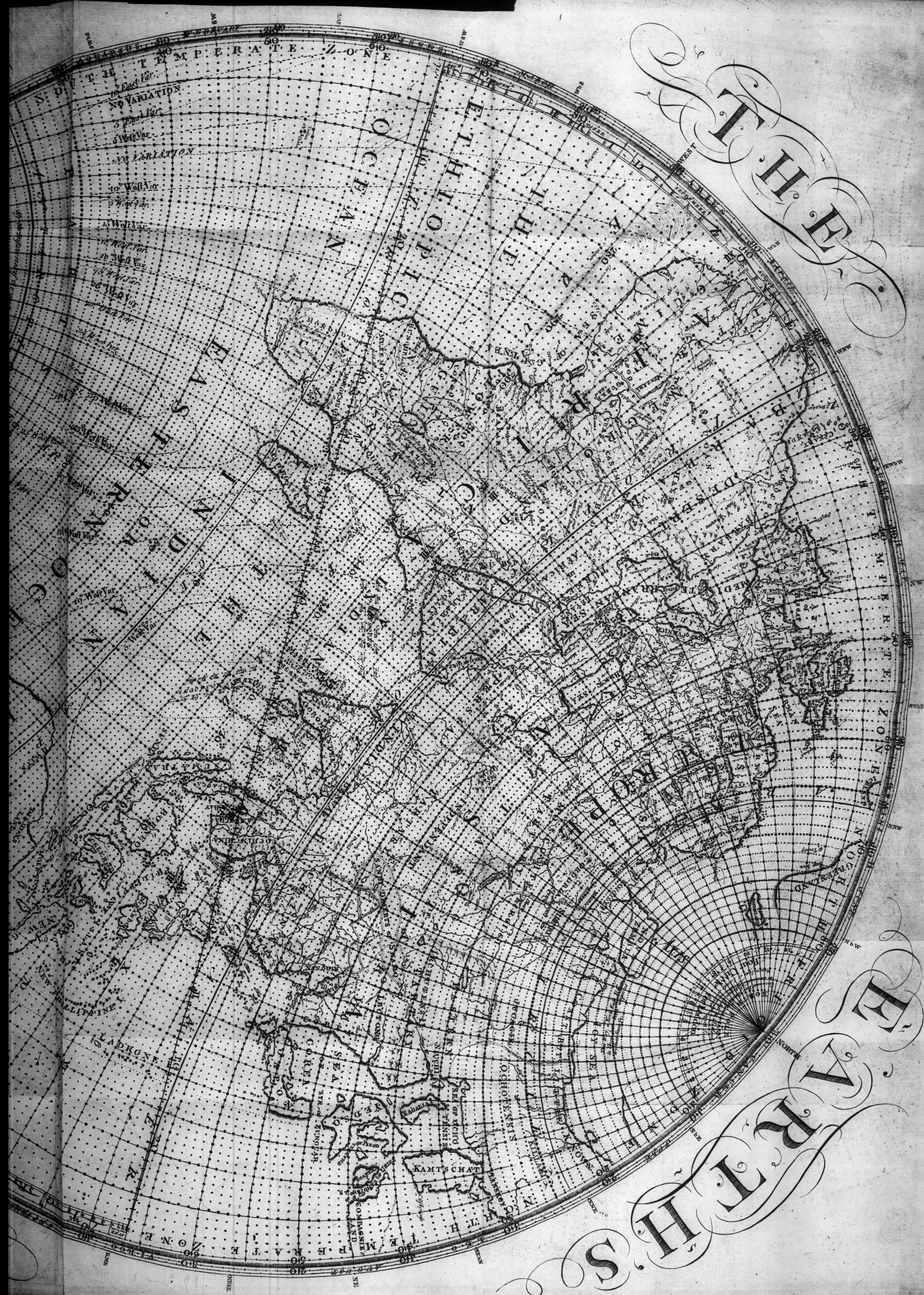
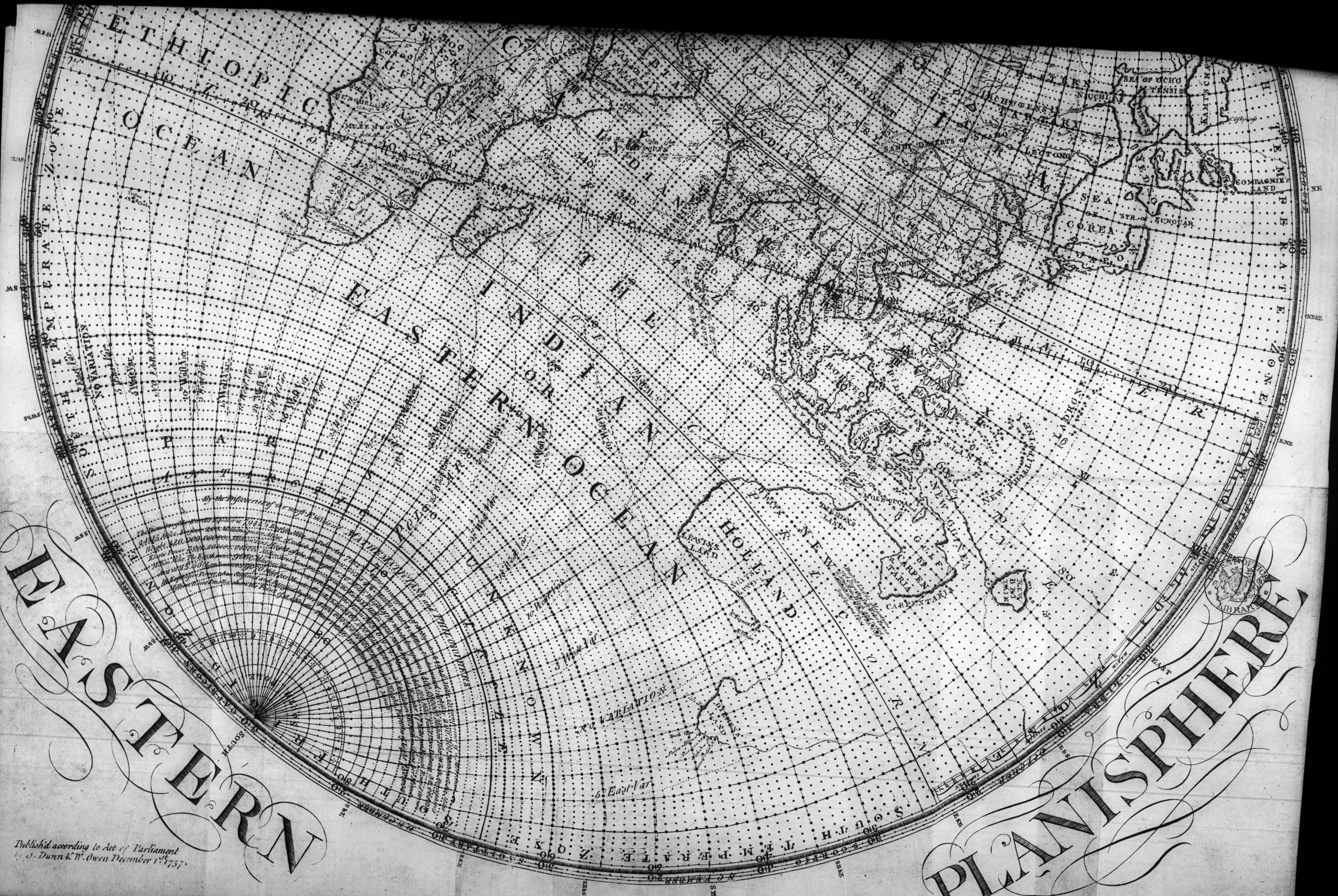

THE
EARTH'S
SOUTH TEMPERATE ZONE
NORTH TEMPERATE ZONE
NORTH TEMPERATE ZONE
ETHIOPIC OCEAN
EAST INDIAN OCEAN
AFRICA
EUROPE
MEDITERRANEAN SEA
NO VARIATION
NO VARIATION
10 West Var.
15 West Var.
20 West Var.
25 West Var.
KAMTSCHATKA
COREA
LADRONE
NEW PHILIPPINE I.
AQUARIUS
ARIES
NORTH



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A DESCRIPTION of the EASTERN TERRESTRIAL PLANISPHERE.

90. THRO' the Centre of this Planiſphere, a right Line is drawn from one Side of the Circumference to the other, repreſenting the *Axis of the World*, about which the diurnal Motion of the Earth is performed from Weſt to Eaſt, or the apparent Motion from Eaſt to Weſt in 24 Hours. The Extremities of this Line repreſent the *North* and *South Poles* of the Earth and Heavens, and on this Line are marked the Degrees of Latitude from the Centre to each Pole. This Line alſo repreſents half the *equinoctial Colure*, paſſing through the Beginning of *Aries*.

At right Angles to this Axis, and through the Centre, a right Line is drawn from one Side of the Circumference to the other, repreſenting half the terreſtrial and celeſtial *Equator*. The Circumference of the Planiſphere is divided into 360 equal Parts for Degrees of Latitude, and numbered on one Side with 10, 20, &c. from the Poles to the Equator; this Circle is a firſt Meridian from which the Longitude of Places may be reckoned, and is placed here for giving a continued View of the great Continent of *Europe*, *Aſia* and *Africa*.

91. At the Diſtance of 23½ Degrees on each Side of the Equator, both in the Circumference and polar Axis, half the *Tropics* of *Cancer* and *Capricorn* are drawn, ſhewing the Sun's greateſt North and South Declination or approach toward the Poles; in like Manner, at the Diſtance of 23½ Degrees from either Pole, the two Semi *polar Circles* are drawn, ſhewing thoſe Places where there is either no Day or no Night when the Sun is in either of the Tropics.

Through the Centre, and from one Extremity of the northern Tropic to the oppoſite Extremity of the ſouthern One, a right Line is drawn, repreſenting half the *Ecliptic*, containing the three ſouthern Signs, *Capricorn*, *Aquarius* and *Piſces*; alſo, the three northern Signs, *Aries*, *Taurus* and *Gemini*, with the Day and Month correſponding to each Degree and Sign, for ſhewing the Sun's Declination, and to what Places he is vertical on any Day at Noon, with his right Aſcenſion, and that Part of the Equation of Time depending on the Difference between his right Aſcenſion and Longitude.

92. From Pole to Pole, are drawn all the Semi *Meridians* at the Diſtance of a Degree from each other. And from one Side of the Planiſphere to the other, at the Diſtance of a Degree from each other, are drawn all the Semi *Parallels of Latitude* from the Equator to the Poles; the former for ſhewing the Difference of Longitudes or Meridians, and the latter the Latitudes of Places, and Zenith Diſtance of the Sun at any given Place on the Planiſphere at Noon. At the North Pole is placed a Semi *hour Circle*, ſhewing the Difference of Meridians in Hours from *London*, and at the South Pole is placed another Semi hour Circle, ſhewing the Difference of Meridians in Hours from the firſt Meridian. Theſe Hours are alſo placed at the *Equinoctial*. Near the Side of the Planiſphere, is placed a Scale of the Months and Days correſponding to thoſe Degrees of *Declination*, oppoſite to them in the Side of the Planiſphere.

93. On the Surface of this Planiſphere is delineated the great Continent of *Europe*, *Aſia* and *Africa*; the ſeveral Empires, Countries, Kingdoms, Iſlands, Rivers, Mountains, Cities, and remarkable Productions of this Part of the known World. Within the *Indian* or eaſtern Ocean, are ſhewn the Directions of the *Monſoons* or periodical Winds in thoſe Seas, the Months when they blow, alſo the *Trade-winds* in the *Ethiopic* Ocean, according to the Direction of the Darts.

Over the *Ethiopic* and *Indian* Oceans, are drawn the *Variation Lines* of the magnetic Needle, as they were obſerved, *Anno* 1700, *Anno* 1744, and *Anno* 1756, the former of which Lines are marked with *Italic* Letters, the next with *Roman*, and the latter with *Italic* Capitals, for ſhewing the Variation of the magnetic Syſtem. In the Side of the Planiſphere are Daſhes, ſhewing the Boundaries of the *Climates*; and at the South Pole, are ſeveral Concluſions relating to the Earth, the Heavens, and the Univerſe.

A DESCRIPTION of the EASTERN CELESTIAL PLANISPHERE.

94. THROUGH the Centre of this Planiſphere, a right Line is drawn for the *Axis of the World*, the Extremities of which repreſent the North and South Poles in the Heavens, the Earth's Globe being ſuppoſed to be in the Centre, and no greater than a Point compared with the Extent of the Heavens; and about this Axis the apparent diurnal Motion is performed, whereby the Stars appear to move from Eaſt to Weſt, and riſe and ſet, under the Direction of the Equator and Parallels of Declination. As a Circle, this Line repreſents the Semi *equinoctial Colure*. At right Angles to the Axis of the World, the Semi *celeſtial Equator* is drawn through the Centre, for ſhewing the Sun's right Aſcenſion as in the terreſtrial Planiſphere. The Circumference of the Planiſphere hath the Degrees of Latitude or Declination from the Equator, and repreſents the *ſolſticial Colure*. This Circle ſhews what Stars will be vertical, or directly over the Inhabitants of any Degree of Latitude, when they come to the Meridian.

95. At the Diſtance of 23½ Degrees from the Equator, the two Semi *Tropics* of *Cancer* and *Capricorn* are drawn, and at the ſame Diſtance from the Poles, are drawn the two Semi *polar Circles*. Through the Centre, and to the Extremities of the two Tropics, is drawn a right Line for the Semi *Ecliptic*, containing the Signs, *Capricorn*, *Aquarius*, *Piſces*, *Aries*, *Taurus*, *Gemini*, and alſo the Days of the Month when the Sun is in thoſe Signs. From Pole to Pole, are drawn the Semi *Meridians*, and from one Side of the Planiſphere to the other, the Semi *Parallels* of *Declination* for ſhewing the right Aſcenſions and Declinations of the Stars. Near the Side of the Planiſphere, between the Tropics, is placed a Scale of *Declination*, for ſhewing the Declination of the Sun on any given Day of the Year.

96. On the Surface of this Planiſphere, are laid down the *fixed Stars* of the eaſtern Hemiſphere, or thoſe on the Eaſt-ſide of the ſolſtitial Colure, with the Names of the Conſtellations to which they belong, and the *Greek* Letters of *Bayer* placed at each Star. The Figures of the Conſtellations, are drawn according to the Antients.

A DECRIPTION of the WESTERN TERRESTRIAL PLANISPHERE.

97. ALL the Semi Circles delineated in the eaſtern terreſtrial Planiſphere are continued, and the other Halfs of them delineated in the ſame Manner, and for the ſame Uſes in this. Beſides, which, on the Surface of this Planiſphere, is delineated the great Continent of North and South *America*, connected by the *Iſthmus* of *Darien*, with the Countries, Kingdoms, Iſlands, Rivers, Trade-winds, Variation Lines, *&c.* of this Part of the known World, as in the eaſtern terreſtrial Planiſphere. So that whatever hath been ſaid in the Deſcription of that, may alſo be applied to this. And theſe two Hemiſpheres being placed to the Back of each other, do compleatly repreſent the whole Globe of the Earth and Sea.

A DESCRIPTION of the WESTERN CELESTIAL PLANISPHERE.

98. THE ſeveral Parts of the weſtern celeſtial Planiſphere, are laid down in the ſame Manner, and for the ſame Purpoſes as thoſe of the celeſtial eaſtern Planiſphere; the *ſolſtitial Colure* being the Circumference of the Planiſphere. A right Line paſſing through the Centre, at right Angles to the polar Axis, containing the other half of the *celeſtial Equator*. And a right Line paſſing through the Centre, to the Extremities of the northern and ſouthern *Tropics*, containing the other ſix Signs, *Cancer*, *Leo*, *Virgo*, *Libra*, *Scorpio*, *Sagittarius*, and the fixed Stars of the weſtern celeſtial Hemiſphere being laid down in this: So that what hath been ſaid of the eaſtern celeſtial Planiſphere, may alſo be underſtood of the weſtern One, the one being the Remainder or Complement of the other. And theſe two being placed to the Back of each other, do repreſent the whole Convex Surface of a Globe of the Heavens.

The PRINCIPLES of GEOGRAPHY.

99. GEOGRAPHY is a Science whereby we underſtand the Situation, Extent, Bounds, Air, Soil, natural Productions, Trade, Commerce, Laws, Cuſtoms and Manners of the various Parts of the known world. For the Underſtanding of which, by the Planiſpheres, it will be proper to place the terreſtrial Planiſpheres before you, as hereby the Bounds and Extent of Countries, the Directions and Lengths of Rivers, the Latitudes and Longitudes of Places, the Extent of the ſeveral Oceans and Seas, the Situation of Places on the Earth's Globe, with reſpect to each other, and to the Circles of the Sphere, will appear by Inſpection, and hence a proper Idea may be formed of the Particulars belonging to each Country.

And here it is to be obſerved, that the uſual Way of introducing the Situation of Places, is by their Latitudes and Longitudes, the former being eaſily obtained by celeſtial Obſervations, and the latter much better adapted for this Purpoſe than any other Poſition that could have been made uſe of in its Stead, on Account of the Uniformity and Regularity which ſubſiſts among the Circles of the Earth and Heavens.

Nor is it any Matter of Conſequence, whether the Geographer begins to reckon Longitude from the Meridian of *London*, *Paris*, or any other Place; ſeeing, in all Caſes, a Perſon with whom he converſes, is ſuppoſed to know where he begins the ſame; and ſhould any Ambiguity of Expreſſion ariſe, the Word *Difference* of Longitude, inſtead of the Word *Longitude* itſelf, will obviate the ſame.

In the following Table the firſt Column contains the principal Diviſions, Empires, and Countries of the Earth's Globe; the ſecond Column expreſſeth the Temperature of the Air for each reſpective Country, or its extreme Parts North and South; the third Column expreſſeth the Soil, which if various and not uniform is marked *different*; the fourth Column expreſſeth the natural Productions, Trade and Commerce, the fifth, ſixth and ſeventh Columns expreſs the general Religion, Language, Manners, and Properties of the Natives.

Coun-

Countries.	*Air.*	*Soil.*	*Productions, Trade & Commerce.*
Spain	hot	dry	Woods and Mountains, Fruits, Wines, Earths, Metals.
France	temperate	fruitful	Corn, Flax, fine Wool, Wines, Silks, Linen, Iron.
Italy	temperate	fruitful	Corn, Wines, Fruit, Sattins, Minerals, Metals.
Hurgary	unwholſome	fertile	Corn, Fruits, Copper, Iron, Salt, Quickſilver.
Poland	cold	fertile	Oak, Deals, Salt-petre, Cordage, Metals.
Pruſſia	cold	woody	Corn, Cattle, Oak, Deals, Hemp, Linen, Metals.
Germany	different	rugged	Metals, Allum, Corn, Linens, Armory.
Holland	temperate	watry	Cattle, Herbs, Fiſh, Linen, Earthen-Ware.
Denmark	cold	fertile	Fiſh, Furs, Skins, Deals, Armour, Pitch, Iron.
Sweden	cold	rocky	Metals, Hydes, Furs, Roſin, Deals, Oak.
Norway	cold	rocky	Fiſh, Train-oil, Furs, Maſts, Pitch, Copper, Hides.
England	temperate	fertile	Corn, Wool, Oak, Butter, Cheeſe, Hard-ware, Armory.
Muſcovy	hot and cold	woody	Furs, Hemp, Soap, Leather, Train-oil, Iron.
Little *Tartary*	temperate	different	Slaves, Leather, Skins, Furs.
Greece	temperate	fertile	Silks, Oil, Leather, Galls, Cotton, Wines, Mohair, Grograms.
Great *Tartary*	different	different	Flax, Muſk, Rhubarb, Silk.
China	temperate	fertile	Gold, Silver, precious Stones, China-ware, Spices, Perfumes.
India	hot	fertile	Drugs, Gums, Spices, Silks, Metals, Minerals.
Perſia	different	different	Silks, Gold, Silver, Skins, Fruits, Alabaſter, Metals.
Arabia	hot	different	Coral, Pearl, precious Stones, Gums, Perfumes.
Euphratia	temperate	fertile	Fruits and Grain, Pitch, Silk.
Egypt	unwholſome	ſlimy	Fruits, Sugar, Linen, Drugs, Flax, Rice Salt.
Barbary	hot	fertile	Honey, Wax, Oil, Sugar, Flax, Hemp, Dates.
The *Deſert*	hot	barren	Wild Cattle, ſome Corn and abundance of Dates.
Negroland	hot	fertile	Indian Corn, Herbs, Metals Gums, Elephant's Teeth, Gold, Slaves.

Religion.	*Language.*	*Manners and Propert. of Inhabit.*
Romaniſts	*Spaniſh*	zealous, jealous, laſcivious, impotent.
Romaniſts	*French*	gay, ſprightly, generous, ingenious.
Romaniſts	*Italian*	polite, eloquent, cunning, revengeful.
Romaniſts	*Hungarian*	ſtrong, valiant, cruel, adicted to war.
Romaniſts	*Sclavonic*	civil, brave, ſincere, ſtrong and long livers.
Lutherans	*Sclavonic*	faithful, ſtrong, patient, valient.
Romaniſts	*German*	ſincere, hoſpitable, valiant, patient, ingenious.
Calviniſts	Low *Dutch*	induſtrious, ingenious, civil, brave.
Lutherans	*Teutonic*	miſtruſtful, ſtrong, valiant.
Lutherans	*Teutonic*	opinionated, vigorous, reſerved, ſtrong,
Lutherans	mix'd	hardy, laborious, courageous, plain, juſt and civil.
Proteſtants	mix'd	ſincere, induſtrious, cautious, ingenious, valiant.
Grecians	*Sclavonic*	conceited, barbarous, long livers, robuſt, ſhort.
Mahometans	*Scytian*	faithful, robuſt, patient, and their Food Horſe-fleſh and Mares-milk.
Mahometans	*Greek*	zealous, charitable, vicious, robuſt, civil.
Mahometans	*Tartarian*	barbarous, ugly, fierce, thieviſh, eaters of human Fleſh.
Pagans	*Chineſe*	conceited, crafty, faithleſs, ingenious.
Idolaters	*Indian*	civil, ingenious, and pretty juſt in Dealing.
Mahometans	*Perſian*	proud, paſſionate, revengeful, Libertines, Flatterers.
Mahometans	*Arabic*	different, ſome ignorant and barbarous, others civil.
Armenians	mix'd	different, but generally like thoſe of *Arabia* and *Greece*.
Mahometans	*Arabic*	treacherous, cruel, Cowards, luxurious, Diviners.
Mahometans	*African*	unfaithful, impatient, covetous, crafty, tawny.
Mahometans	*African*	wild, barbarous, thieviſh, tawny.
Idolaters	*African*	barbarous, rude, ignorant, luxurious, vicious, black.

Countries.	*Air.*	*Soil.*	*Productions, Trade & Commerce.*
Guinea	hot	fertile	Gold, Ivory, Ambergreaſe, Grain, Fruit, Wax, Civet, Slaves.
Nubia	hot	fertile	Gold, Ivory, Sugar, Drugs, Crocodiles.
Southern *Africa*	hot	different	Gold, Silver, Metals, Gems, Corn, Cattle, Wines, Salt.
Mexico	warm	fertile	Cotton, Sugar, Silk, Cochineal, Tobacco, Drugs.
Florida	temperate	fertile	Gold, Silver, Pearls, Furs, Indigo, Wild-beaſts.
Canada	temperate	fertile	Fiſh, Grain, Deals, Iron, Tar, Beaſts, Beavers, Deers, Tobacco.
Terra Firma	hot	fertile	Gold, Silver, Metals, Gums, precious Stones, Drugs.
Peru	different	rich	Vaſt Quantities of Gold and Silver, with Drugs, Pearls, Cotton.
Amazonia	temperate	fertile	Gold, Silver, Sugar, Cocoa, Ebony, Tobacco, Wild-beaſts.
Brazil	temperate	fertile	Brazil Wood, Sugar, Amber, Tobacco, Train-oil, Roſin, Gold, Diamonds.
Paraguay	temperate	fertile	Gold, Silver, Braſs, Iron, Sugar, Wild-beaſts.
Chili	different	different	Gold, Silver, Corn, Honey, Oſtriches, Metals.

There are alſo many Iſlands diſperſed throughout the ſeveral Oceans and Seas, and alſo Places on the Continents of great Trade and Commerce, ſome of which are ſubject to *European* Nations, and others neutral with them. Such as the *Azore*, *Madeira*, and *Cape-Verd* Iſlands, poſſeſſed by the *Portugueſe*; *Newfoundland*, belonging to the *Engliſh*; the Iſles of *Cape-Breton* and *St. John*, now taken from the *French* by the *Engliſh*, and which, on Account of Situation, may be eſteemed a Bar to the River *St. Laurence*, and all the Settlements thereon, the Sand-Banks in theſe Seas being general Fiſheries for Cod-fiſh, Stock-fiſh and Lyng, which thoſe Seas produce in great Abundance, and from which they are exported to *Portugal*, *Spain*, *France*, *England*, and other Nations. *Greenland*, both Eaſt and Weſt, the general Whale-fiſhery for the *Engliſh*, *Dutch*, *Danes*, and other *European* Nations, the Coldneſs of the Climate permitting but few Inhabitants, a few wandering Savages, with Plenty of large, white Bears, icy Seas, and Mountains of Snow. *Iceland*, inhabited by a few *Danes* and *Norwegians*, the Air cold, the Inhabitants healthy, long livers, and the

Religion.	*Language.*	*Manners and Propert. of Inhabit.*
Pagans	*Zungai*	naked, proud, thieviſh, black.
Pagans	*Nubian*	cunning, warlike, fierce, wealthy.
Pagans	*Ethiopic*	in general ignorant, treacherous, fierce Savages.
Papiſts & Idolaters	*Spaniſh* and *Indian*	civil, honeſt, faithful Natives.
Ditto	*French* and *Indian*	Ditto with painted Bodies almoſt naked, Warriors.
Ditto and *Engliſh*	Ditto and *Engliſh*	Ditto and *Engliſh*.
Idolators	various	tawny, robuſt, healthy, almoſt naked.
Idolators	*Spaniſh* and *Indian*	vicious, ſome ignorant, other ingenious.
Pagans	not known	fierce Savages, eating human Fleſh.
Scarce any	various	cruel, revengeful, thieviſh.
Idolaters	*Jargon*	ſtout, tall, nimble, laborious.
Idolaters	*Jargon*	tall courageous, warriors, valiant.

the Produce of the Country, Leather, Tallow, Fiſh-oil, Fiſh and Skins. *Jamaica*, well inhabited by the *Engliſh*, producing Sugar, Rum, Ginger, and otherwiſe a great Mart for the Trade and Commerce of the *Weſt Indies*. St. *Chriſtophers*, *Antegoa*, *Monſerrat*, poſſeſſed by the *Engliſh*, producing great Quantities of Cotton, Sugar, Tobacco. *Barbadoes*, extremely populous, and producing great Quantities of Sugar, Rum, Cotton. Moſt of the other *Caribbee* Iſlands inhabited by the *Spaniards* and *French*. T *Fuego*, an uninhabited Iſle ſouth of *America*. *Madagaſcar*, a wild deſert Iſland, having but few, if any, *European* Inhabitants. St. *Helena*, belonging to the *Engliſh*, where our *Eaſt India* Ships take freſh Supplies of Water. *Sumatra*, producing Gold and other Metals, Drugs and Spices. *Java*, inhabited by the *Dutch*, producing Rice, Honey, Sugar. *Japan*, producing Gold, Silver, Wheat, Rice, Pearls. Alſo, on the Continent of *America*; the Coaſts of *Hudſon's Bay* and *New Britain*, belonging to the *Engliſh*, producing great Quantities of Beavers and Furs, but few Natives. *New Scotland*, belonging to the *Engliſh*, a Country capable of great Improvement.

ment, and producing Timber, Hemp, Cordage, Wheat, Fruits. *New England*, numerouſly inhabited by the *Engliſh*, a fertile Country, the Inhabitants healthy, robuſt, ſincere, courageous; alſo *New York*, *Penſilvania*, *Maryland*, *Virginia*, North and South *Carolina*, *Georgia*, abounding with fine Rivers, plenty of Fiſh, great Quantities of Tobacco, and many other mercantile Commodities, the Natives chiefly *Britiſh* Inhabitants, whoſe Geniuſes for Trade and Commerce have led them to theſe Parts of the World, where they have eſtabliſhed Colonies, built ſpacious Towns, ſettled Factories, and under the *Britiſh* Government export the Produce of thoſe Countries, import that of others, a People apt for Improvements in Arts, Sciences and Learning, generous, ſtrong and brave, equal to any Enterprize, and biding fairly to equal, if not outvy any other Part of the known World.

On the Coaſt of *Africa* and *Corimandel*, *Bengal*, *Malabar*, and ſeveral other Places in *Eaſt India*, the *Engliſh* have ſeveral Places of great Conſequence for ſecuring the Trade of theſe Parts of the World, as have likewiſe the *Spaniards*, *Portugueſe*, *Dutch* and *French*, the Prerogative of which is generally retained for the immediate Benefit of the ſeveral Crowns and Princes which have been able to make Acquiſitions in thoſe Parts of the World, or for Companies of Merchants impowered by Royal Charters for carrying on Courſes of Traffic with the ſame.

100. *An Eſtimate of the Magnitudes of Countries compared with each other.*

England and *Scotland*	1	*Sweden* and *Norway*	3 [illegible]/6
Ireland	⅗	*Muſcovy*	12
France	3½	*Poland*	3
Spain and *Portugal*	2½	*Turkey* in *Europe*	5
Italy	1½	*Turkey* in *Aſia*	6
Germany	3	*Eaſt India*	20
Holland and *Flanders*	⅓	*China* and *Tonquin*	18
Denmark	⅘	*Arabia*	15

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101. *An Eſtimate of the Number of Inhabitants in the following Countries.*

England —	7 Millions.
Scotland —	$1\frac{1}{2}$ Mill.
Ireland —	2 Mill.
Holland —	2 Mill.
Flanders —	2 Mill.
France —	16 Mill.
Spain and *Portugal*	6 Mill.
Italy — —	7 Mill.
Germany —	20 Mill.
Pruſſia and *Poland*	5 Mill.
Denmark, Sweden and *Norway*	5 Mill.
Muſcovy —	12 Mill.

Turkey in *Europe*	8 Millions.
China —	50 Mill.
Perſia —	12 Mill.
India —	20 Mill.
Britiſh Empire in *America*	1 Mill. Whites.
French in *Canada* and *Florida*	$\frac{1}{3}$ Mill. Whites.
Spaniards in *America*	3 Mill. Whites.

102. *An Eſtimate of the Number of Land Forces uſually employed in Time of Peace in the following Countries.*

England —	40 Thouſands.
Holland —	30 Thouſ.
France —	160 Thouſ.
Spain —	60 Thouſ.
Portugal —	20 Thouſ.
The Pope's Dominions	8 Thouſ.
Naples —	20 Thouſ.
Tuſcany —	8 Thouſ.
Venice —	20 Thouſ.
Sardinia —	30 Thouſ.

Queen of *Hungary*	120 Thouſands.
Pruſſia —	100 Thouſ.
Poland —	40 Thouſ.
Saxony —	20 Thouſ.
Bavaria —	20 Thouſ.
Hanover —	20 Thouſ.
Denmark —	30 Thouſ.
Sweden —	35 Thouſ.
Muſcovy —	150 Thouſ.

103. *An Eſtimate of the Proportion of Shipping, including thoſe of War and Commerce, belonging to the following Countries.*

England — —	1
Holland — —	1
France — — —	$\frac{1}{3}$
Spain and *Portugal* —	$\frac{1}{4}$

Germany and *Pruſſia* —	$\frac{1}{8}$
Denmark — —	$\frac{1}{5}$
Sweden and *Ruſſia* —	$\frac{1}{3}$

104. *A* TABLE, *ſhewing the Money of Account, the Money and Par of Exchange, and the real Species of the Chief trading Countries of* Europe.

THE Countries and Cities with which England has the greateſt Commerce, are *Holland* or *Amſterdam*, *Brabant* or *Antwerp*, *France* or *Paris*, *Germany*, *Hamburgh*, *Spain*, *Portugal*, *Venice*, *Genoa* and *Leghorn*.

In *England*, Books and Accompts are kept in Pounds, Shillings, Pence and Farthings. A Pound is 20 Shillings, a Shilling 12 Pence, and a Penny 4 Farthings.

The Exchange between this and other Countries is negotiated in Pounds and Pence.

The real Species of Gold is a Guinea (or 21 Shillings) and its Sub-diviſions: That of Silver is a Crown, or 5 Shillings, its Half is 2*s.* 6*d.* The next of Silver is a Shilling, and the next is a Sixpence: Of Copper a Halfpenny, and a Farthing.

In *Holland*, Books and Accompts are kept in Gilders, or Florins, Stivers, and Penningens. A Gilder is 20 Stivers: A Stiver is 16 Penningens.

The Exchange between this and other Countries, is by allowing a certain Number of Pounds, or Groots Flemiſh, for the reſpective Species of theſe Countries. A Flemiſh Pound contains 20 Flemiſh Skillings: A Skilling contains 12 Groots, and a Groot Flemiſh is half a Stiver, conſequently a Gilder is 40 Groots, and a Pound Flemiſh is 6 Gilders. — Sometimes the Exchange is by Rixdollars, one of which is 2 $\frac{1}{2}$ Gilders.

The real Species of Gold, are the Ducat or Ducatoon of 20 Gilders. The Sovereign is 15 Gilders or Florins. The Roſe Noble is 11 Gilders. The real Species of Silver and Copper are, the Ducatoon of 3 Gilders 3 Stivers. The Drie Gulden is 3 Gilders. The Rixdollar is 2 $\frac{1}{2}$ Gilders. The Crown is 2 Gilders. The Dollar is 1 $\frac{1}{2}$ Gilder. The Gold Florin is 1 Gilder 8 Stivers. The Skilling is 6 Stivers, or 12 Groots. The Stiver is 2 Groots, or 16 Penningens or Deniers. The Male Skilling is 5 Stivers 8 Deniers. The Doublekee is 2 Stivers.

The intrinſic Value of a Florin or Gilder is 1*s.* 9*d.* $\frac{6}{10}$ *Engliſh*, and conſequently a Groot is $\frac{54}{100}$ of an *Engliſh* Penny.

In *Brabant*, *Antwerp*, *&c.* Books and Accompts are kept in Pounds, Skillings and Groots Flemiſh, and Exchange negotiated in the ſame Species. The Reſt as in *Holland*, only 96 Groots Flemiſh are here 4*s.* 6*d.* *Engliſh*, and conſequently 1 Groot Flemiſh is $\frac{9}{10}$ of an *Engliſh* Penny.

In *France*, Books and Accompts are kept in Livres, Solz, and Deniers. A Livre is 20 Solz, and a Sol is 20 Deniers.

The Exchange is negotiated by Ecus, or Crowns of 3 Livres, or 60 Solz Tournois.

The real Species of Gold, are double and ſingle Louis d'Ors. Of Silver a Crown, or Ecu, and its Sub-diviſions: Une Petite Piece is 3 $\frac{1}{2}$ Solz, or three Pence *Engliſh*. — Of Braſs a Sou. Of Copper a Liard, or Farthing, and a Denier $\frac{1}{12}$ of a Sol.

The intrinſic Value of a Louis d'Or is 17*s.* 0*d.* of a Crown in Specie 4*s.* 6*d.* of a Sol $\frac{9}{10}$ of a Penny *Engliſh*.

The current Value of the ſeveral Species in *France* alters at the King's Pleaſure: The Crown in Specie lately paſſed there for 72 Solz Tournois, and therefore then the intrinſic Value of the Ecu of Exchange of 3 Livres or 60 Solz Tournois was 45 Pence *Engliſh*. The Value of the Ecu of Exchange is according to the current Value of the Ecu in Specie.

In *Hamburgh*, Books and Accounts are kept in Rixdollars or Marks, Skillings and Pfennings. A Rixdollar is 3 Marks, a Mark is 16 Skillings, or Stivers Lubs, and a Skilling is 12 Pfennings.

The Exchange with *London* is by Pounds, Skillings, and Groots Flemiſh. A Groot Flemiſh is $\frac{1}{2}$ a Skilling, or Stiver Lubs: A Skilling Flemiſh is 6 Stivers Lubs, and a Pound Flemiſh is 7 $\frac{1}{2}$ Marks, or 120 Stivers Lubs.

The real Species are a Gold Ducat, worth 6 Marks, and 8 or 9 Stivers Lubs. A Silver Ducatoon is 3 Marks 14 Stivers Lubs. An Albertus, or Croſs Rixdollar is 3 Marks 4 Stivers Lubs. The current Rixdollar is 3 Marks. A *Daniſh* Crown is 2 Marks. The Dollar is 2 Marks. The Mark is 16 Stivers Lubs. The Skilling is 6 Stivers Lubs, and the current Stiver is 2 Groots current.

The intrinſic Value of the Mark is 1*s.* 6*d.* *Engliſh*, by which the Value of all the Reſt may be eſtimated.

In *Spain*, Books and Accompts are kept in Rials and Maravedies. A Rial is 34 Maravedies.

The Money of Exchange is a Piaſtre, or Piece of Eight, of 8 Rials, or 272 Maravedies. A Ducat of 375 Maravedies, and a Piſtole of 1088 Maravedies.

The real Species are, the Piſtole of Gold of 4 Peſoes. The half Piſtole. The Peſo, Piaſtre, or Piece of Eight, is 8 Rials. The Rial is 34 Maravedies.

The intrinſic Value of the Peſo is 4*s.* 6*d.* *Engliſh*, conſequently a Maravedie is $\frac{27}{34}$ of an *Engliſh* Farthing.

In *Portugal*, Books and Accompts are here kept in Rees, the Thouſands being ſeparated from the Hundreds by this Mark —, and the Millions from the Thouſands by a Dot ●.

Exchange is negotiated by allowing a certain Number of Rees for the Species of other Countries, *viz.* the half Piſtole, or Millree of 1000 Rees, and the Cruſado of 400 Rees.

The real Species are, the broad Ducat of Gold of 10,000 Rees. The double Piſtole is 40000 Rees. The Piſtole is 2000 Rees. The half Piſtole is 1000. The ſtamped Patacoon is 600. The current Patacoon is 500. The ſtamped Cruſado is 500. The current Cruſado is 400. The ſtamped Pezzo of *Portugal* is 480, and the Teſtoon is 100 Rees.

The Value of a Millree is 84*d.* *Engliſh*, conſequently a Ree is $\frac{336}{1000}$ of an *Engliſh* Farthing.

At *Venice*, Books and Accompts are kept in Lires, Soldi, and Denari. A Lire is 20 Soldi: A Soldo is 12 Denari.

The Exchange is by Ducats and Groſſes Banco; a Ducat Banco being 24 Groſſes Banco.

The real Species are, a Piſtole of 29 Lires; a Sequin 17 Lires; a Silver Ducat 6 Lires 4 Soldi; a Teſton 2 Lires 14 Soldi; a Jule is $\frac{1}{8}$ of a Teſton, or 18 Soldi; a Lire is 20 Soldi; a Soldo is 12 Pichioli; a Groſs is 2 Soldi 8 Pichioli, or 32 Pichioli.

The intrinſic Value of a Lire is 7*d.* $\frac{1}{5}$ *Engliſh*, and of a Silver Ducat 44*d.* 64 *Engliſh*: But the Ducat Banco being 20 *per Cent.* better than the currant Ducat, and 40 *per Cent.* better than the Pichioli, is 53*d.* 57 *Engliſh*, conſequently the Groſs Banco is 2*d.* 23 *Engliſh*.

At *Genoa*, Books and Accompts are kept in Pezzi, Lires, Soldi, and Denari. A Pezzo is 5 Lires. A Lire is 20 Soldi; and a Soldo is 12 Denari.

The Money of Exchange is the Crown, of 4 Lires; and the Pezzo, of 5 Lires.

The real Species are, the Piſtole, of 18 Lires; the Pezzo, of 5 Lires; the Lire; the Soldo; the Croiſade, of 7 Lires 10 Soldi; and the Teſton, of 1 Lire 12 Soldi.

The intrinſic Value of a Lire, is 10*d.* $\frac{4}{5}$ *Engliſh*.

At *Legborn*, Books and Accompts are kept in Pezzi, or Dollars, Soldi, and Denari: A Pezzo, or Dollar, is 6 Lires: A Lire is 20 Soldi: A Soldo is 12 Denari.

The Money of Exchange is the Pezzo, or Dollar.

The real Species is the Pezzo, of 6 Lires.

The intrinſic Value whereof is 4*s.* 6*d.* *Engliſh*.

105. *A* TABLE, *ſhewing the Par of Exchange with the Chief trading Places in* Europe.

HOLLAND or AMSTERD.	20 Shillings for 37*s.* 0*d.* $\frac{4}{8}$ Flem.	AMSTERDAM.		
BRABANT or ANTWERP	20 Shillings for 35*s.* 6*d.* $\frac{2}{3}$ Flem.	20*s.* 0*d.* Flem. for 19*s.* 2*d.* $\frac{2}{5}$ Flem.	ANTWERP.	
FRANCE or PARIS.	45 Pence for 1 Ecu of 60 Sols Tournois	83 $\frac{1}{3}$ Groots for 1 Ecu.	80 Groots for 1 Ecu.	PARIS.
GERMAN. or HAMBUR.	20 Shillings for 35*s.* 6*d.* $\frac{2}{3}$ Flem	20 *s.* 0 *d.* Flem. for 19*s.* 2*d.* $\frac{2}{5}$ Flem	96 Groots for 48 Stivers Lubs.	1 Ecu for 40 Stivers Lubs.
SPAIN.	54 Pence for 1 Piece of Eight of 272 maraved.	137 $\frac{59}{68}$ Groots for a Ducat of 375 Maravad.	132 $\frac{6}{17}$ Groots for a Ducat.	1 Ecu for 226 $\frac{2}{3}$ Maravad.
PORTUGAL.	6*s.* 9*d.* Sterling for a Millree.	60 Groots for a Cruſadoe of 400 Rees.	57 $\frac{3}{5}$ Groots for a Cruſado of 400 Rees.	1 Ecu for 555 $\frac{5}{9}$ Rees.
VENICE.	53 57 Pence for a Ducat Banco.	99 $\frac{1}{8}$ Groots for a Ducat Banco.	95 $\frac{95}{124}$ Groots for a Ducat Banco.	100 Ecus for 84 Ducats Banco.
GENOA	54 Pence for a Pezzo.	100 Groots for a Pezzo.	96 Groots for a Pezzo.	1 Ecu for 83 $\frac{1}{8}$ Soldi.
LEGHORN.	54 Pence for a Pezzo or Dollar.	100 Groots for a Pezzo.	96 Groots for a Pezzo.	100 Ecus for 83 $\frac{1}{8}$ Pezzi.

HAM-

HAMBURGH.				
$134\frac{6}{7}$ Groots for a Ducat.	SPAIN.			
$57\frac{3}{5}$ Groots for a Cruſadoe.	100 Ducats for $299\frac{53}{68}$ Cruſad.	PORTUGAL.		
$95\frac{20}{123}$ Groots for a Ducat Banco.	$269\frac{103}{125}$ Maravedies for a Ducat Banco.	$661\frac{1}{3}$ Rees for a Ducat Banco.	VENICE.	
96 Groots for a Pezzo.	272 Maravedies for a Pezzo.	$666\frac{2}{3}$ Rees for a Pezzo.	$119\frac{1}{2}$ ſoldi for 4 Lires.	GENOA.
96 Groots for a Pezzo.	272 Maravedies for a Pezzo.	$666\frac{2}{3}$ Rees for a Pezzo.	100 Ducats Banco for $99\frac{1}{5}$ Pezzi.	Pezzo for Pezzo.

Note, Exchange is very variable, and the Courſe or Rate at any particular Time, is only to be known from Merchants reſiding at the Places.

106. *A* TABLE, *ſhewing the foreign Gold and Silver Coins.*

Gold Coins.	*Weight.*		*Value.*		
	pwts.	*gr.*	*l.*	*s.*	*d.*
SPaniſh Piſtole	4	8	0	16	6
French Piſtole	4	8	0	16	6
French Lewis	4	8	0	16	6
Hungary Ducat	2	6	0	9	8
Holland Rider	6	10	1	5	9
Flanders Albertus	3	8	0	13	0
Double Sovereign of Flanders	6	$3\frac{1}{2}$	1	8	6
Gilder of Prothono	2	3	0	6	10
Gilder of Matthias Emperor	2	3	0	7	2
Gilder of Nuremburg	2	3	0	7	1
Italian Piſtole	4	6	0	16	4
Chickeen of Venice	2	7	0	9	7
Half Cardinal Angel	1	20	0	6	4
A Daniſh Coin with a Crown on one Side of it	3	20	0	15	4
Moidore with their Halves, Quarters and Eighths	6	11	1	7	0
Johns, with their Halves, &c.	9	6	1	16	0
Double Johns, of	18	12	3	12	0

Silver Coins.	*oz.*	*pwts.*	*gr.*	*s.*	*d.*	*f.*
Ducatoon of Flanders	1	0	22	5	4	0
Holland Dollar	0	18	5	4	4	0
Lyon Dollar	0	17	8	3	4	2
Rixdollar of the Empire	0	18	15	4	5	3
Seville Royal	0	17	12	4	4	3

Mexico

	oz.	pws.	gr.	s.	d.	f.
Mexico Royal	0	17	12	4	4	2
Old Cardecue	0	6	3½	1	6	1
French Lewis	0	17	11	4	4	1
St. Mark of Venice	0	10	4	2	6	0
Single Milrez of Portugal	0	7	2	1	9	0
Double Dutch Stiver	0	1	0	0	1	3
Zealand Dollar	0	10	0	2	7	2
Croſs Dollar	0	18	0	4	2	1
Old Philip Dollar	1	2	0	5	0	0
Ferdinand Dollar, 1623	0	18	6	4	3	1
Prince of Orange Dollar, 1624	0	18	6	4	3	3
Daniſh Dollar, 1620	0	13	0	2	11	1
New Quarter of French Lewis	0	4	9	1	1	0
Portugal Teſtoon	0	4	9	1	1	0

107. *A* TABLE *of the Climates from the Equator to the Polar Circles.*

Clim.	Longeſt Day.	Latitude		Breadth.		Clim.	Longeſt Day.	Latitude		Breadth.	
	h.	°	′	°	′		h.	°	′	°	′
1	12½	8	34	8	25	13	18½	59	59	1	33
2	13	16	43	8	9	14	19	61	18	1	19
3	13½	24	11	7	28	15	19½	62	25	1	7
4	14	30	47	6	36	16	20	63	23	0	58
5	14½	36	30	5	43	17	20½	64	16	0	53
6	15	41	22	4	52	18	21	64	55	0	39
7	15½	45	29	4	7	19	21½	65	25	0	30
8	16	49	1	3	32	20	22	65	47	0	22
9	16½	51	58	2	57	21	22½	66	6	0	19
10	17	54	29	2	31	22	23	66	20	0	14
11	17½	56	37	2	12	23	23½	66	28	0	8
12	18	58	26	1	49	24	24	66	31	0	3

Climates between the Polar Circles and the Poles.

	Months	°	′	°	′		Months	°	′	°	′
1	1	67	31	1	0	4	4	78	20	5	0
2	2	69	31	2	0	5	5	84	0	5	40
3	3	73	21	3	30	6	6	90	0	6	0

108. *A* TABLE *of the Equality of* Weights, *at the moſt conſiderable Places in* Europe.

100 ℔ at are equal to	Holland or Amſterdam.		Brabant or Antwerp.		Rouen.		Lions.		Rochel.		Tholouſe.		Province or Marſeilles.		Geneva.		London.		Hamburgh.	
Amſterdam,	100		105	8	96	4	116		99		118		123	8	89		109	8	102	
Antwerp,	94	12	100		91	4	110		93	13	111	12	117		84	5	102	12	96	10
Rouen,	104		109	12	100		120	8	102	15	122	11	128	8	92	9	113	14	106	
Lions	86		90	12	82	12	100		85	2	101	8	106	4	76	8	94	3	87	12
Rochel	101		106	8	97	3	117		100		119	3	124	12	89	14	110	9	103	
Tholouſe	84	12	89	6	81	8	98	5	83	15	100		104	11	75	7	92	6	86	7
Marſeilles,	81		85	8	78		94		80	3	95	9	100		72		88	11	82	10
Geneva,	112	6	118	8	105		130	5	111	6	132	9	128	4	100		123		114	10
London,	91	8	96	8	88		106		90	9	107	11	113		81	7	100		93	5
Hamburgh,	98		103	6	94	4	113	10	97		119	10	121		87	4	107	5	100	
Francfort,	102	6	107	8	98	3	118	5	101		120	6	126		90	12	111	11	104	
Leipſick,	95	4	100		91	12	110	8	94	4	112	6	117	12	84	12	104	5	46	2
Genoa,	$66\frac{2}{3}$		70	5	64		77	5	66		78	10	82	5	59	5	73		68	
Leghorn,	69		72	12	66	6	114	13	68	5	81	6	85	4	61	6	65	9	70	6
Milan,	59	8	62	12	57	4	69		58	14	70	12	73	8	53		65	3	60	11
Venice,	60		63	6	57	12	69	10	59	6	70	13	72	2	53	6	65	11	61	3
Naples,	59		62	4	57		68	7	58	6	69	10	72	14	52	8	64	10	60	2
Spain,	94	8	99	12	91		109	10	93	9	111	8	116	11	84	2	103	7	96	6
Portugal,	87	8	92		84	4	101	8	96	10	103	4	108		77	14	95	4	89	4
Leige.	95		100	3	91	7	110	3	94		112		117	5	84	8	104		96	14

A Table of the Equality of Weights, &c.

100 ℔ at are equal to	Franckfort.	Leipſick, Naumburgh, Hall.	Genoa.	Leghorn.	Milan.	Venice.	Naples.	Sevil, Cadiz.	Liſbon.	Leige.
Amſterdam,	98	105	150	145	168	166	169	106	114 8	105 4
Antwerp,	92 13	99 8	142 2	137 6	159 3	157 ⅓	160 2	100 8	109 8	99 11
Rouen,	102	109 4	156	150 13	174 11	172 2/2	170 12	110 4	119	109 7
Lions,	84 4	90 5	129	124 11	144 8	142 ¾	145 6	91 3	98 8	90 8
Rochel,	99	106	151 8	146 7	169 11	167 10	170 11	107	115 10	106 5
Tholouſe,	83	91 8	127 2	122 14	142 6	140	144 4	89 13	97	89 3
Marſeilles,	79 6	87 8	121 8	117 7	136 1	134 8	136 14	85 13	92 12	85 4
Geneva,	110 2	119	168 9	163	188 13	186 8	189 14	119 2	128 8	118 4
London,	89 7	96 1	137 4	132 11	153 11	152	154 10	97	104 13	96 5
Hamburgh,	96	102 15	147	142 2	164 10	162 11	167 10	103 13	112 4	103 2
Francfort,	100	107 1	153	147 14	171 6	169 5	172 6	108 2	116 13	107 6
Leipſick,	93 5	100	142 13	138 1	160	158 2	161	101	109	100 4
Genoa,	64 5	70	100	96 11	112	110 11	112 11	70 11	76 5	70 6
Leghorn,	67 10	72 8	103 8	100	116	114 8	116 9	73	79	72 10
Milan,	58 5	62 8	89 4	86 4	100	98 12	100 8	63	68 2	62 5
Venice,	58 13	63	90	87	100 13	100	101 6	63 9	68 11	63 2
Naples,	57 13	62	88 8	85 8	99 2	98	100	62 8	67 9	62
Spain,	92 10	99 4	141 12	141 12	158 12	156 14	159 12	100	108 3	99 14
Portugal,	85 12	91 13	131 4	131 4	147	145 4	148	92 12	100	92
Leige.	93	99 12	142 8	142 8	159 9	157 11	160 10	100 9	108 12	100

Note, The Weights of *Paris*, and other Places of *France*, being almoſt equal to thoſe of *Amſterdam*; they are all comprehended under thoſe of *Amſterdam*.

For the like Reaſon, the Weights of *Nuremberg* are comprized under thoſe of *Francfort*.

109. *A* TABLE *of the Equality of* Long Meaſures, *at the moſt conſiderable Places in* Europe.

		Ells of Holland.	Ells of Brabant.	Ells of England, Francfort, &c.	Ells of Hamb Francfort, &c.	Ells of Breſlaw.	Ells of Dantzick.	Ells of Berguen.	Ells of Sweden	Ells of St. Gall for Linnen.	Ells of St. Gall for Woollen.	Ells of Geneva.	Canes of Marſeilles.
100 Ells of Holland,	make	100	98$\frac{3}{4}$	58$\frac{1}{2}$	120	125	112$\frac{1}{2}$	110	117	86	112	60	35
100 Ells of Brabant,		101	100	60	121$\frac{1}{2}$	126$\frac{3}{5}$	114	111$\frac{4}{5}$	118$\frac{1}{2}$	87	113$\frac{4}{5}$	69$\frac{3}{4}$	35$\frac{4}{5}$
100 Ells of England,		171	166	100	205$\frac{1}{4}$	213$\frac{3}{4}$	192$\frac{4}{5}$	188	200	147	191$\frac{1}{2}$	102$\frac{3}{5}$	59$\frac{4}{5}$
100 Ells of Hamburgh,		83$\frac{1}{3}$	82$\frac{1}{3}$	48$\frac{4}{5}$	100	104$\frac{1}{5}$	92$\frac{3}{5}$	91$\frac{3}{4}$	97$\frac{1}{2}$	71$\frac{2}{5}$	91$\frac{1}{3}$	50	29$\frac{1}{5}$
100 Ells of Breſlaw,		80	79	46$\frac{3}{5}$	96	100	89$\frac{4}{4}$	88	93$\frac{3}{5}$	68$\frac{3}{4}$	89$\frac{3}{5}$	48	28
100 Ells of Dantzick,		89	87$\frac{3}{4}$	52	96$\frac{4}{5}$	111$\frac{1}{4}$	100	98	104$\frac{2}{5}$	76$\frac{3}{5}$	99$\frac{3}{4}$	53$\frac{4}{5}$	31$\frac{1}{5}$
100 Ells of Berguen,		90	89	52$\frac{3}{4}$	108	112$\frac{1}{2}$	101$\frac{1}{4}$	100	105$\frac{1}{3}$	77$\frac{4}{5}$	100$\frac{4}{5}$	54	31$\frac{1}{2}$
100 Ells of Sweden,		86	84	50$\frac{3}{5}$	103$\frac{1}{5}$	107$\frac{1}{2}$	96$\frac{3}{4}$	94$\frac{3}{5}$	100	74	66$\frac{1}{3}$	51$\frac{3}{5}$	30$\frac{1}{5}$
100 Ells of St. Gall,		116	114$\frac{1}{4}$	67$\frac{3}{4}$	139$\frac{1}{5}$	145	130$\frac{1}{2}$	127$\frac{3}{5}$	135$\frac{3}{4}$	100	130	69$\frac{3}{5}$	40$\frac{3}{5}$
100 Ditto, for Woollen,		89$\frac{1}{8}$	88$\frac{4}{5}$	52$\frac{1}{4}$	107$\frac{1}{5}$	111$\frac{3}{4}$	100$\frac{1}{4}$	98$\frac{1}{4}$	104$\frac{1}{2}$	76$\frac{4}{5}$	100	53$\frac{3}{5}$	31$\frac{1}{4}$
100 Ells of Geneva,		166$\frac{2}{3}$	164$\frac{1}{5}$	97$\frac{1}{2}$	200	208$\frac{1}{3}$	187$\frac{1}{2}$	183$\frac{1}{4}$	195	143$\frac{1}{3}$	130$\frac{2}{3}$	100	58$\frac{1}{3}$
100 Canes of Marſeilles,		286	282$\frac{4}{5}$	167$\frac{1}{3}$	343$\frac{1}{5}$	357$\frac{1}{2}$	321$\frac{3}{4}$	314$\frac{3}{5}$	334$\frac{3}{5}$	246	320$\frac{1}{3}$	171$\frac{3}{5}$	100
100 Canes of Toulouſe,		266$\frac{2}{3}$	263$\frac{1}{3}$	156	320	333$\frac{1}{3}$	300	193$\frac{1}{4}$	312	229$\frac{1}{3}$	298$\frac{1}{3}$	160	93$\frac{1}{3}$
100 Ditto, of Genoa, 9 Palms,		327	323	191$\frac{1}{3}$	362$\frac{4}{5}$	408$\frac{3}{4}$	367$\frac{4}{5}$	359$\frac{3}{4}$	382$\frac{3}{5}$	281$\frac{1}{2}$	366$\frac{1}{4}$	196$\frac{1}{5}$	114$\frac{1}{2}$
100 Canes of Rome,		303	299$\frac{1}{5}$	177$\frac{1}{4}$	363$\frac{3}{5}$	378$\frac{3}{4}$	340$\frac{4}{5}$	333$\frac{1}{3}$	454$\frac{1}{2}$	260$\frac{3}{5}$	339$\frac{4}{5}$	181$\frac{4}{5}$	116
100 Yards of England,		133$\frac{1}{3}$	131$\frac{2}{3}$	78	160	166$\frac{3}{5}$	150	146$\frac{3}{5}$	156	114$\frac{3}{5}$	149$\frac{1}{3}$	80	46$\frac{2}{3}$
100 Yards or Barra's of Spain,		125	113$\frac{4}{5}$	73$\frac{1}{5}$	150	156$\frac{1}{4}$	140$\frac{2}{3}$	137$\frac{1}{2}$	146$\frac{3}{5}$	107$\frac{1}{2}$	140	75	43$\frac{3}{4}$
100 Barra's of Portugal,		164	162	96	196$\frac{4}{5}$	205	184$\frac{1}{2}$	180$\frac{4}{5}$	191$\frac{4}{5}$	141	183$\frac{3}{5}$	94$\frac{4}{5}$	57$\frac{4}{5}$
100 Cavido's of Portugal,		100	98$\frac{3}{4}$	58$\frac{1}{2}$	120	125	112$\frac{1}{2}$	110	117	86	112	60	35
100 Braces of Venice,		98	96$\frac{3}{4}$	57$\frac{1}{2}$	117$\frac{3}{5}$	122$\frac{1}{2}$	104$\frac{1}{4}$	107$\frac{3}{4}$	115	84$\frac{1}{4}$	109$\frac{3}{4}$	58$\frac{3}{4}$	34$\frac{1}{3}$
100 Braces of Bergam,		95	93$\frac{4}{5}$	55$\frac{3}{5}$	114	118$\frac{3}{4}$	106$\frac{3}{4}$	104$\frac{1}{2}$	111$\frac{1}{5}$	81$\frac{3}{4}$	106$\frac{4}{5}$	57	33$\frac{1}{4}$
100 Braces of Florence,		85$\frac{1}{2}$	84$\frac{4}{5}$	50	102$\frac{3}{5}$	106$\frac{4}{5}$	96$\frac{2}{3}$	94	100	73$\frac{1}{2}$	95$\frac{3}{4}$	51$\frac{3}{5}$	30
100 Braces of Milan.		78	77	45$\frac{3}{5}$	93$\frac{3}{5}$	97$\frac{1}{2}$	87$\frac{3}{4}$	87$\frac{3}{4}$	91$\frac{1}{4}$	67	87$\frac{3}{5}$	46$\frac{4}{5}$	27$\frac{4}{5}$

PATENT OFFICE LIBRARY

A TABLE *of the Equality of* Long Meaſures, *&c.*

		Canes of Touloufe.	Canes of Genoa.	Canes of Rome.	Yards of England.	Yards and Barra's of Spain.	Barra's of Portugal.	Cavido's of Portugal.	Braces of Venice.	Braces of Bergam, Bologn.	Braces of Florence, Leghorn.	Braces of Milan.
100 Ells of Holland,	make	37½	30½	33	75	80	61	100	102	105¼	116½	128½
100 Ells of Brabant,		38	30⅘	33⅘	76	81	61¾	101¼	103¼	106¼	118	130
100 Ells of England,		64⅕	52⅕	56⅘	128¼	136⅘	104⅓	171	174⅘	179	199⅕	219
100 Ells of Hamburgh,		31¼	25⅘	27½	62½	65⅘	50⅘	83⅓	85	88½	97	107
100 Ells of Breſlaw,		30	24⅘	26⅘	60	64	48⅘	80	81⅗	84⅘	93⅕	102⅘
100 Ells of Dantzick,		33⅘	27⅕	29⅘	66 4/4	71⅕	54⅓	89	90¾	93⅗	103¾	114½
100 Ells of Berguen,		33¾	26¼	29¾	67½	72	55	90	91¾	94¾	105	115¾
100 Ells of Sweden,		32¼	35⅘	28⅘	64½	68⅘	52½	86	87¾	90½	100⅕	110½
100 Ells of St. Gall,		43½	27⅕	28⅓	87	92⅘	70¾	116	118⅗	122	135⅕	149
100 Ditto, for Woollen,		33½	27⅘	29 1/1	67	71½	54½	89⅓	91⅕	94	104	114¾
100 Ells of Geneva,		62½	50⅘	55	124¾	133⅓	101⅔	166⅔	170	172⅘	193⅓	214⅕
100 Canes of Marſeilles,		107¼	87¼	94⅘	214½	228⅘	174¾	286	291¾	301	333⅕	367½
100 Canes of Toulouſe,		100	81⅓	88	199¾	213⅓	162⅔	266⅔	272	280⅗	309⅓	342⅔
100 Ditto, of Genoa, 9 Palms,		122⅗	100	108	245¼	261⅗	199½	327	333½	344⅕	381	420⅕
100 Canes of Rome,		113⅔	92⅘	100	227⅕	242⅘	184⅘	303	309	319	353	339⅘
100 Yards of England,		50	40⅔	44	100	107	81⅓	133⅓	136	104⅓	154¾	171⅓
100 Yards or Barra's of Spain,		46⅘	38⅕	41¼	93¾	100	76¼	125	127½	131½	145⅗	159⅔
100 Barra's of Portugal,		61½	50	54⅕	123	131⅕	100	164	167¼	172⅗	191	210¾
100 Cavido's of Portugal,		37½	30½	33	75	80	61	100	102	105¼	116½	128½
100 Braces of Venice,		36¾	29¾	32⅓	73½	78⅘	59¾	98	100	103⅕	114⅕	126
100 Braces of Bergam,		35⅗	29	31⅗	72¼	76	58	95	97	100	100⅗	122
100 Braces of Florence,		32	26⅕	28⅕	65⅕	68⅘	52⅕	85½	87⅕	95	100	109⅘
100 Braces of Milan,		29¼	23⅘	25¾	58½	62⅘	47½	78	79½	82⅕	91	100

Note, The Ells of *England* and *France* are equal, alſo the Ells of *Hamburgh* and *Francfort*, Canes of *Marſeilles* and *Montpelier*, Braces of *Florence* and *Leghorn*.

110. *A* TABLE *of* Engliſh *Coins, Weights and Meaſures.*

Money.

Farthings.			
4	1 Penny.		
48	12	1 Shilling.	
960	240	20	1 Pound.

Long Meaſure.

Barley Corns.						
3	1 Inch.					
36	12	1 Foot.				
108	36	3	1 Yard.			
594	198	16½	5½	1 Pool.		
23760	7920	660	220	40	1 Furlong.	
190080	63360	5280	1760	320	8	1 Mile.

Troy Weight.

Grains.			
24	1 Pennywt.		
480	20	1 Ounce.	
5700	240	12	1 Pound.

Land Meaſure.

Links.				
625	1 Pole.			
25000	40	1 Rood.		
100000	160	1	1 Acre.	
64000000	102400	2560	640	1 Mile.

Superficial Meaſure.

Inches.		
144	1 Foot.	
1296	9	1 Yard.

Time.

Seconds.				
60	1 Minute.			
3600	60	1 Hour.		
86400	1440	24	1 Day.	
31556937	525949	8766	365¼	1 Year.

Solid Meaſure.

Inches.		
1728	1 Foot.	
46656	27	Yard.

Avoirdupoize Weight.

Drams.				
16	1 Ounce.			
256	16	1 Pound.		
28672	1792	112	1 Hundred.	
573440	35840	2240	20	1 Ton.

Apothecaries Weight.

Grains.				
20	1 Scruple ℈			
60	3	1 Dram ʒ		
480	24	8	1 Ounce ℥	
5760	288	96	12	1 Pound.

Wine Meaſure.

Solid Inches.					
231	8 Pints	1 Gallon.			
14553	504	63	1 Hogſhead.		
29106	1018	126	2	1 Pope.	
58212	2016	252	4	2	1 Tun.

Beer Meaſure.

Sol. Inches.					
282	8 Pints	1 Gallon.			
2538	72	9	1 Firkin.		
5076	144	18	2	1 Kilderkin.	
10152	288	36	4	2	1 Barrel.

III. *A* TABLE *of the* GENERAL POST.

BY a Statute made in the 9th Year of Queen ANNE, the following Rates are appointed to be paid for Poſt Letters:

England, *or* South-Britiſh *Inland Letters and Packets.*

	Sing.		Dou.		Tre.		Oun.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
From *London*, to, or from any Place not exceeding 80 Miles Diſtance.	0	3	0	6	0	9	1	0
And to and from any Place above 80 Miles from *London*.	0	4	0	8	1	0	1	4

North Britain *Letters and Packets.*

	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
From *London* to *Edinburgh*, *Dumfreys*, or *Cock-burn-ſpeth*, and the Contrary.	0	6	1	0	1	6	2	0
From *Edinburgh*, not exceeding 50 Miles in *Scotland.*	0	2	0	4			0	8
From any Place above 50 Miles, and not exceeding 80 Miles in *Scotland.*	0	3	0	6			1	0
And if to, or from any Places above 80 Miles from *Edinburgh* in *Scotland*, &c.	0	4	0	8			1	4

Ireland *Letters and Packets.*

From *London* to *Dublin*, and the Contrary.	0	6	1	0			2	0
From *Dublin*, to, or from any Place not exceeding 40 *Engliſh* Miles.	0	2	0	4			0	8
If above 40 Miles from *Dublin*.	0	4	0	8			1	4

Foreign Letters and Packets.

	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
From any Part of *Holland*, *France*, or *Flanders*, and from all Parts whatſoever, coming by Way of *Holland* to *London*; and alſo from *London* to *Hamburgh* only.	0	10	1	8	2	6	3	4
To or from *London*, and any Part of *Spain* and *Portugal* through *France*, or by Packet Boats.	1	6	3	0	4	6	6	0
To or from *London*, and any Part of *Italy*, *Sicily*, *Turkey*, *Switzerland*, *Alſace* and *Nancy*, *Barleduc*, and *Luneville* in *Lorrain*, thro' *France*.	1	3	2	6	3	9	5	0
From *London* to any Part of *Italy*, *Sicily*, *Germany*, *Switzerland*, *Denmark*, *Sweden*, *Ruſſia*, and all Parts of the North through *Holland*; and from each of theſe Places coming by Way of *Flanders*.	1	0	2	0	3	0	4	0

The Poſtage of Letters, to any of the following Places, muſt be paid for before they are ſent, viz.

	s.	*d*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
For all Letters or Paquets to any Part of *Spain* or *Portugal.*	1	6	3	0	4	0	6	0
For all Letters or Paquets to any Part of *Italy* or *Sicily*, by Way of *Lyons*, or to *Turkey*, by Way of *Marſeilles.*	1	3	2	6	3	9	5	0
For all Letters or Packets to any Part of *Italy* or *Sicily*, *Germany*, *Switzerland*, *Denmark*, *Sweden*, and all Parts of the North, paſſing through the *Spaniſh* Netherlands, or United Provinces.	1	0	2	0	3	0	4	0
For all Letters and Pacquets to *Hamburgh.*	0	10	1	8	2	6	3	4

The Poſt Days from *London*, to any Part of *England* and *Scotland*, are *Tueſdays*, *Thurſdays*, and *Saturdays*; and the Returns on *Mondays*, *Wedneſdays*, and *Fridays:* But to *Wales* and *Ireland*, the Poſt goes only twice a Week, *viz. Tueſdays* and *Saturdays*, and returns from *Wales* every *Monday* and *Friday*; but from *Ireland* the Return is uncertain.

To *France*, *Spain* and *Italy*, *Monday* and *Thurſday*.

To *Holland*, *Germany*, *Denmark* and *Sweden*, *Tueſday* and *Friday*.

To *Flanders*, and from thence to *Denmark* and *Sweden*, *Monday* and *Friday.*

To *Spain*, by the Way of *Falmouth* from *London*, every other *Tueſday*, and from *Falmouth* by Packet-boats to the *Groyne*.

The Mails *are due from foreign Parts as follows:*

From *Holland*, *Monday* and *Friday*.
From *France*, *Wedneſday* and *Saturday*.
From *Flanders*, *Monday* and *Thurſday*.
From *Ireland*, *Monday*, *Wedneſday* and *Friday*.
From *Spain*, *Portugal*, *&c.* once a Week.

By a late Order from the Poſtmaſter-general, Packets and Letters are forwarded monthly from *London* to his Majeſty's Iſlands in the *Weſt-Indies*, and alſo to and from the ſeveral Colonies on the Continent of *North-America*, viz.

From *London* to the Iſlands of *Barbadoes*, *Antegoa*, *Montſerrat*, *Nevis*, St. *Chriſtopher*'s, and *Jamaica:* And,

From *London* to *New York*, *New-England*, *Virginia*, *Maryland*, and all other Colonies on the Continent of *North-America*.

THE

Geographical and *Aſtronomical* PROBLEMS.

112. PROBLEM I.

TO find the Latitude of a Place given.

Example.

What is the Latitude of *London?*

Operation.

Guide your Eye either to the right or left Side of the Planiſphere, under the Parallel of *London*; and you have 51° $\frac{1}{2}$, the Latitude required.

Examples for Practice.

Places.	Latitudes.

113. *Problem* II. To find the Difference of Latitude between two Place given.

Example. What is the Difference of Latitude between *London* in *England*, and *Cape Frio* in *South America?*

Operation. The Latitude of *London* is 51° $\frac{1}{2}$ N. the Latitude of *Cape Frio* is 22° $\frac{1}{2}$ S. whoſe Sum is 74°, the Difference of Latitude required. If the Places had been one in North, the other in South Latitude, their *Difference* would have been the Difference of Latitude required.

Examples for Practice.

Places.	Places.	Diff. of Latitude.

114. *Problem* III. To find the Longitude of a Place given.

Example. What is the Longitude of *London*, ſuppoſing the firſt Meridian to be that of the Planiſphere?

Operation. Guide your Eye from thence to the Meridian of *London*, and you have 17° $\frac{3}{4}$, the Longitude Eaſt required.

Examples for Practice.

Places.	Longitudes.

115. *Problem* IV. To find the Longitude of a Place when the Meridian of *London* is the firſt Meridian.

Example. What is the Longitude of *Prague*, ſuppoſing Longitude to begin at the Meridian of *London?*

Operation. Count from the Meridian of *London* to that of *Prague*, and you have the Anſwer.

Note, If one Place be in one Planiſphere, and the other Place in the other Planiſphere, the Degrees from one Place to the other muſt be counted, and this is the Longitude either Eaſt or Weſt as the Caſe ſhall be.

Examples for Practice. Suppoſing Longitude to begin at the Meridian of *London.*

Places.	Longitudes.

116. *Problem* V. To find the Difference of Longitude between two Places.

Example. What is the Difference of Longitude between the *Land's End*, or Weſt Point of *England*, and the *Cape Good Hope?*

Operation. Count from the Meridian of the *Land's End*, to the Meridian of *Cape Good Hope*, and you have for the Difference of Meridians or Difference of Longitude required.

Examples for Practice.

Places.	Places.	Diff. of Longitude.

117. *Problem* VI. To find a Place whoſe Longitude and Latitude are given.

Example. What is that Place whoſe Longitude is 21° $\frac{1}{4}$ Eaſt of *London*, and Latitude 45° $\frac{1}{2}$ North ?

Operation. Guide your Eye along the given Parallel of 45° $\frac{1}{2}$ North until you come to a Place 39° of Longitude Eaſt of *London*, and you have a Place near *Belgrade*, which was required.

Examples for Practice.

Latitudes.	Latitudes.	Places.

118. *Problem* VII. To find what o'Clock it is at one given Place, when it is a given Hour at another given Place.

Example. What o'Clock it is at *Canton* in *China*, when it is 5 o'Clock Afternoon at *London?*

Operation. Count from the Meridian of *London* to the Meridian of *Canton*, and it is 113°, or 7 Hours 32 Minutes later, or 12 Hours 32 Minutes, the Hour required.

If one of the Places had been in the weſtern Planiſphere, you muſt have counted Weſtward, and it would have been ſooner than at *London*.

Examples for Practice.

Hours.	Places.	Places.	Hours.

119. *Problem* VIII. To find the Number of ſquare Miles in a Country.

Example. How many ſquare Miles are in *Portugal?*

Operation. Meaſure its Length, and apply it to the Meridian near that Place, it meaſures $5^\circ \frac{1}{2}$, Meaſure the Breadth, apply it to the ſame, and you have $1^\circ \frac{1}{2}$. Multiply the Length and Breadth together, and you have $8^\circ \frac{1}{4}$, which multiplied by 3600, the ſquare Miles in one ſquare Degree, gives 29700 ſquare Miles, the Anſwer. Irregular Countries ſhould be divided into long Squares, and each meaſured.

Examples for Practice.

Places.	Square Degrees.	Square Miles.

120. *Problem* IX. To find how many Miles go to a Degree of Longitude in any Parallel of Latitude.

Example. How many Miles go to a Degree of Latitude in the Parallel of *London?*

Operation. Take 6 Degrees of Longitude near *London*, and apply it to its Meridian near the ſame Place, and you have $3\frac{3}{4}$ Degrees of the Meridian anſwerable thereto, which is ſo many Times Ten, or $37\frac{1}{4}$ Miles, the Anſwer.

Examples for Practice.

Places.	Miles.

121. *Problem* X. To find how many Degrees of Longitude go to a Degree of Latitude or Diſtance in any Parallel.

Example. How many Degrees of Longitude make a Degree of Latitude or Diſtance in the Parallel of the Lizard?

Operation. Take 6 Degrees of Latitude, and apply it to the Parallel of the Lizard, both near the ſame, and you have $9\frac{1}{3}$ an-

anſwering thereto, which is ſo many Times Ten, or 93 Minutes, the Anſwer.

Examples for Practice.

Places.	Degrees.

122. *Problem* XI. To find how many Miles an Hour a Perſon moves in any Parallel of Latitude, by the Motion of the Earth round its Axis.

Example. How many Miles an Hour doth *London* move, by the Motion of the Earth round its Axis, in a Day?

Operation. Take 15 Degrees of Longitude at *London*, and apply it to the Meridian there, ſo you have the Number of Degrees *per* Hour, which multiplied by 60, gives the Miles required.

Examples for Practice.

Places,	Miles *per* Hour.

123. *Problem* XII. To find the *Antœci* of a given Place.

Example. What Inhabitants are *Antœci* to the *Arabians?*

Operation. Guide your Eye to the ſame Degree of South Latitude, as is the Latitude of the *Arabian* Inhabitants North, and upon the ſame Meridian, and you will come to *Madagaſcar* Iſle, the Place required.

Examples for Practice.

Places.	*Antœci.*

124. *Problem* XIII. To find the *Periæci* of a given Place.

Example. What Inhabitants are *Periæci* to the *Perſians?*

Operation. Guide your Eye along the Parallel of *Perſia*, until you come to a Place 180 Degrees of Longitude therefrom, and you come to *California*, whoſe Inhabitants are thoſe required.

Examples for Practice.

Places.	*Periæci.*

125. *Problem* XIV. To find the *Antipodes* of a given Place.

Example. What Inhabitants are *Antipodes* to *China?*

Operation. Guide your Eye along the Parallel of *China*, until you come to a Place 180 Degrees of Longitude therefrom, then guide your Eye to the ſame Degree of South Latitude, as is the Latitude of *China* North, and you come to *Peru*, whoſe Inhabitants are thoſe required.

Examples for Practice.

Places.	*Antipodes.*

126. *Problem* XV. To find what Climate a given Place is in.

Example. What Climate is *London* in?

Operation. Guide your Eye along the Parallel of *London*, to the Side of the Planiſphere, and you have the Beginning of the Ninth Climate required.

Examples for Practice.

Places.	Climates.

127. *Problem* XVI. Given the Month and Day to find the Sun's Place in the Ecliptic.

Example. What is the Sun's Place in the Ecliptic, *May* 1ſt?

Operation. Guide your Eye along the Ecliptic, and oppoſite to *May* 1ſt you have *Taurus*, 11° ½, the Place required. Otherwiſe you have the ſame in the Circumference of the Planiſphere. Otherwiſe in the aforegoing Tables.

Examples for Practice.

Times.	Place in Ecliptic.

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128. *Problem* XVII. Given the Month and Day to find the Sun's right Aſcenſion.

Example. What is the Sun's right Aſcenſion, *April* 25?

Operation. Guide your Eye along the Ecliptic until you come to *April* 25 thereon, then guide your Eye downward along the Meridian of that Place, and you come to 33° ½ on the Equator, the right Aſcenſion required.

Examples for Practice.

Times.	Right Aſcenſions.

129. *Problem* XVIII. Given the Month and Day to find the Sun's Declination.

Example. What is the Sun's Declination, *May* 10?

Operation. Find *May* 10 in the Scale of Declination near the Side of the Planiſphere, and on the graduated Meridians you have 17 ¾ North, the Declination required. Otherwiſe it may be found in the aforegoing Tables.

Examples for Practice.

Times.	Declination.

130. *Problem* XIX. To find all thoſe Places where the Sun will be vertical on any Day at Noon.

Example. To what Parts of the Earth and Sea will the Sun be vertical, *June* 21 at Noon?

Operation. Find *June* 21 in the Scale of Declination near the Side of both Planiſpheres, and guiding your Eye along the Parallel of Declination, you paſs over *Barbary*, *Arabia*, *India*, *Bengal*, alſo the *Atlantic Ocean*, *Mexico*, and the *Pacific Ocean*, the Places required.

Examples for Practice.

Times.	Places.

131. *Problem* XX. To find where the Sun is vertical on a given Day, and at a given Hour.

Example. Where is the Sun vertical, or in the Zenith on *Auguſt* 1ſt, when it is 9 o'Clock in the Morning at *London?*

Operation. Firſt find the Parallel of Declination for *Auguſt* 1ſt, which is near 18° North; then, becauſe the Sun is 3 Hours ſhort of the Meridian of *London* at the given Hour, guide your Eye 3 Hours or 45 Degrees of Longitude Eaſtward on the ſaid Parallel, and you come to *Arabia Felix*, the Place required.

Examples for Practice.

Times.	Places.

132. *Problem* XXI. To find how many Degrees the Sun will be North or South of the Zenith of a given Place, on a given Day.

Example. How much will the Sun be South of the Zenith of *London*, on *July* 3d?

Operation. For *July* 3, on the Scale of Declination, you have 23° North, the Sun's Declination, from which, counting on the Meridian of *London* to *London*, you have 28° ½, the Zenith Diſtance required.

Examples for Practice.

Times.	Places.	Zenith Diſtance.

133. *Problem* XXII. To find the longeſt Day and ſhorteſt Night at a given Place.

Example. What Length is the longeſt Day at *London?*

Operation. Find the Latitude of *London*, and it is 51° ½ North, then counting 51° ½ from the North Pole, ſtretch the Silken-thread to that Point in the Circumference, and obſerve where it cuts the northern Tropic; count from this Point to the Side of the Planiſphere, and you have for one Side the half Day, and for the other Side the half Night, reckoning 15 Degrees of Longitude for an Hour, and a Degree of Longitude for 4 Minutes of Time; ſo you have 8 Hours 12 Minutes and ½ for half the longeſt Day, and 3 Hours 47 Minutes and ½ for the ſhorteſt Night required.

Examples for Practice.

Places.	Longeſt Day.	Shorteſt Night.

134. *Problem* XXIII. To find what Hour the Sun will riſe or ſet at any given Place on a given Day.

Example. What Hour will the Sun riſe and ſet at *Liſbon*, *May* 30th?

Operation. Find the Sun's Declination, *May* 30, and it is near 22° North; find the Latitude of *Liſbon*, and it is 39°

North. Count 39° from the North Pole of the Planiſphere in the Circumference, and ſtretch the Silken-thread thereto, obſerving where it cuts the Parallel of 22° North, from which Point, count to the Side of the Planiſphere, ſo you have 4 Hours 44 ¼ Minutes the Time of Sun-riſing, and 7 Hours 15 ¾ the Time of Sun-ſetting required.

Examples for Practice.

Times.	Places.	Riſing.	Setting.

135. *Problem* XXIV. To find the Length of the Day or Night, at a given Place on a given Day.

Example. What is the Length of the Day, and alſo of the Night at *Copenhagen*, *May* 20?

Operation. Find the Latitude of *Copenhagen*, and it is 55° ¾ North. Find the Declination of the Sun for *May* 20, and it is 20 North: Find the Hour of Sun-riſing, as in the laſt Problem, it is 3 Hours 51 Minutes, which doubled, gives 7 Hours 42 Minutes the Length of the Night. Find the Hour of Sun-ſetting, it is 8 Hours 9 Minutes, which doubled, is 16 Hours 18 Minutes, the Length of the Day.

Examples for Practice.

Times.	Places.	Day Length.	Night Length.

136. *Problem* XXV. To find what Day the Sun begins to appear above the Horizon, at a given Place in the Frigid Zone.

Example. On what Day doth the Sun begin to appear at *Trinity-Iſle* near *Greenland?*

Operation. Find the Latitude of *Trinity-Iſle*, it is 71° ½ N. Count 90 Degrees South therefrom on the Meridian, and you come to 18° ½ South, which Declination anſwers to *January* 27, the Anſwer.

Examples for Practice.

Places.	Times.

137. *Problem* XXVI. To find on what Point of the Horizon the Sun riſes or ſets at a given Place, and on a given Day.

Example. On what Point of the Horizon will the Sun riſe and ſet at *London*, *January* 30th?

Operation. Find the Sun's Declination, it is 17° $\frac{3}{4}$ South; and the Latitude of *London*, which is 51° $\frac{1}{2}$ North; ſtretch the Silken-ſtring to 51 $\frac{1}{2}$ in the Side of the Planiſphere, and ſlide the Bead on the String until it cuts the Parallel of 17 $\frac{3}{4}$ South. Turn about the Thread until it coincides with the Equator or Axis of the World, and the Bead will meaſure ° from the Centre, which is the Amplitude from the South required.

Examples for Practice.

Places.	Times.	Amplitudes.

138. *Problem* XXVII. To find that Part of the Equation of Time which depends upon the Sun's Place in the Ecliptic, and his Right Aſcenſion.

Example. What is the Difference between the Sun's Place in the Ecliptic, and his Right Aſcenſion, *April* 20th?

Operation. Find the Sun's Place in the Ecliptic, it is $\frac{3}{4}$ of a Degree in *Taurus*, hence his Longitude from *Aries* is 30° $\frac{3}{4}$; guide your Eye downward on the Meridian to the Equator, and you come to 28° $\frac{2}{3}$ of Right Aſcenſion, hence the required Difference is 2° $5'$, or 8 Minutes 20 Seconds of Time.

Examples for Practice.

Times. Differences.

139. *Problem* XXVIII. To find the whole Equation of Time.

Example. What is the Equation of Time, *April* 20th?

Operation. Look in the Table of the Sun's Place, *&c.* and in the laſt Column thereof you have 1 Minute 18 Seconds, which good Clocks and Watches are after the Sun, the Anſwer.

Examples for Practice.

140. *Problem* XXIX. To find what Hour a Planet, Comet, or New Star will riſe or ſet; its Right Aſcenſion and Declination, and the Latitude of the Place being given.

Example. What Hour will a Celeſtial Phenomenon riſe and ſet, whoſe Right Aſcenſion is 38°, and Declination 20° South, *February* 3d, at *London?*

Operation. Find the Sun's Declination, it is 16° 35′ South, his Right Aſcenſion is 316° 40′. Find the Sun's Semi diurnal Arch, it is 4 Hours 33′. And the Phenomenon's Semi diurnal Arch, 4 Hours 11′. But the Sun is near 5 ½ Hours of Right Aſcenſion before the Phenomenon, therefore he will ſet about 4 ½ o'Clock, and the Phenomenon at about 10 ½ in the Evening.

Examples for Practice.

141. *Problem* XXX. To find all thoſe Places where a Comet will be vertical, its Declination being given.

Example. Where will a Comet be vertical whoſe Declination is 30° North?

Operation. Guide your Eye along the Parallel of 30° North, and you have *China*, *India*, *Perſia*, *Barbary*, the *Atlantic Ocean*, *Florida*, and the *Pacific Ocean* required.

Examples for Practice.

142. *Problem* XXXI. To find the Diſtance of two Places on the eaſtern and weſtern Planiſpheres.

Example. What is the Diſtance from *London* to *Fort St. George?*

Operation. With a Pin or Needle, place the Centre of the Slider over the Centre of the eaſtern Planiſphere, and turn the Slider round the Centre, until ſome Meridian of the Slider paſſeth through *London* and *Fort St. George*, then count from one of theſe Places to the other on the ſaid Meridian, and you have 74 Degrees, the required Diſtance, which multiplied by 60, gives 4440 geographical Miles.

Examples for Practice.

Places.	Places.	Diſtances.

143. *Problem* XXXII. To find through what Countries a great Circle paſſeth, in leading from one given Place on the Planiſphere, to another given Place on the ſame.

Example. Through what Countries doth a great Circle paſs, in leading from *London* to *Jeruſalem?*

Operation. Place the Centre of the Index over the Centre of the eaſtern Planiſphere, and turn round the Index until a Meridian thereon paſſeth through *London* and *Jeruſalem*; then will the ſame Meridian paſs between *France* and *Flanders*, alſo through Part of *Germany*, *Turkey* in *Europe*, *Archipelago*, and the Bottom of the *Mediterranean* Sea, which are the Places required.

Examples for Practice.

144. *Problem* XXXIII. To find the Diſtance of two Places, one of which is in the Eaſtern, and the other in the weſtern Planiſphere.

Example. What is the Diſtance from the *Lizard* to *Jamaica?*

Operation. Firſt find the Difference of Longitude between the *Lizard* and *Jamaica*, which being 72°, put a black Patch on the Eaſtern Planiſphere at 72° Eaſt Longitude from the *Lizard*, and in the Parallel of *Jamaica*. Turn round the Index until a Meridian thereof paſſeth through the *Lizard* and the Patch, ſo you have 64° ½ by counting thereon from the *Lizard* to the Patch, for the Diſtance required, which multiplied by 60, gives 3870 Miles.

Examples for Practice.

Places.	Places.	Diſtances.

145. *Problem* XXXIV. To find thoſe Parts of the Earth and Sea over which a great Circle will paſs, in leading from one Place on one Planiſphere, to another Place on the other Planiſphere.

Example. Over what Parts of the Earth or Sea will a great Circle paſs, in leading from *London* to *Cape Horn?*

Operation. Find the Diſtance in the ſame Manner as the laſt Problem. Then, becauſe *London* is 17° ¾ of Longitude Eaſt from the Side of the Planiſphere, obſerve how many Degrees of Longitude it is from *London* to where that Meridian which meaſures the Diſtance, cuts a Parallel of Latitude 17° ¾ of Longitude Eaſt of *London*, which being the Parallel of 27° North; turn Z on the Index to 27° in the Side of the Planiſphere, ſo the Meridian paſſing through *London*, gives the Anſwer for the Eaſtern Planiſphere. In like Manner, bring Z to 27° in the Side of the Weſtern Planiſphere, and the Meridian paſſing thro' *Cape Horn*, over the *Atlantic Ocean*, is the other Part of the Anſwer required.

Examples for Practice.

Places.	Places.	Places.

146. *Problem* XXXV. To find the Poſition of two Places with the Meridian, when both Places are on one Planiſphere.

Example. Which Way doth *Canton* in *China* bear from *London?*

Operation. Turn round the Slider until a Meridian thereof paſſeth through *London* and *Canton*, on which Meridian, at the Diſtance of 90° from *London* place a Patch, count 90° Southward on the Meridian of *London*, and there alſo put another Patch; then turn the Slider round until a Meridian paſſeth thro' both theſe Patches, on which Meridian you may count 120° from one Patch to the other, which is N. E. by E. ¼ E. nearly, the Bearing required.

Examples for Practice.

Places.	Places.	Bearings.

147. *Problem* XXXVI. To find the Poſition of Places with the Meridian, when one Place lyeth in one Planiſphere, and the other Place in the other Planiſphere. *Ex-*

Example. Which Way doth *Barbadoes* bear from *London*?

Operation. Find the Difference of Longitude between *London* and *Barbadoes*, which being 59° Weſt, place a black Patch at 59° Longitude, either Eaſtward from the Side of the Eaſtern Planiſphere, or Weſtward from the Side of the Weſtern Planiſphere, and in the Parallel of *Barbadoes*; then counting *London* to be in the Parallel of 51° $\frac{1}{2}$ at the Side of the Planiſphere, proceed as in the laſt Problem, ſo you have the Bearing W. S. W. $\frac{1}{2}$ W. nearly, which was required.

Examples for Practice.

Places.	Places.	Bearings.

148. *Problem* XXXVII. To find where a great Circle, paſſing over the Earth's Surface, will come neareſt to the Pole.

Example. If a great Circle paſs through *London* and the North *Cape*, where will it come neareſt to the North Pole?

Operation. Turn the Slider until a Meridian thereof paſſeth through *London* and the North *Cape*, then will the ſame Meridian alſo paſs neareſt to the North Pole in Latitude 76° $\frac{3}{4}$ North, and Longitude 76° Eaſt of *London*, which is a little North of the Middle of the Coaſt of *Nova Zembla*, the Place required.

Examples for Practice.

Places.	Places.	Neareſt à Pole.

149. *Problem* XXXVIII. To draw a Meridian, or North and South Line at any Place on the Earth's Globe.

Example. I would draw a Meridian Line on the Floor of a Room, whoſe Window faceth the South?

Operation. Firſt, with a Pair of dividing Compaſſes, draw ſeveral Circles having the ſame Centre, but ſome wider than others; erect a Pin or ſtrait Wire in the Centre perpendicularly, and obſerve in the Forenoon, where the Shadow of the Top of the Wire falls on one of theſe Circles, making a Mark at the ſame, obſerve where the Shadow of the Top of the Wire falls on the ſame Circle after Noon, and a right Line drawn from one of the Marks to the other, is the Eaſt and Weſt Line, from which the North and South is had by Biſection at Right-angles.

Examples for Practice.

150. *Problem* XXXIX. To find the Variation of the Magnetic Needle.

Example. I would find the Variation of the Magnetic Needle at *London*, or any other Place on Land.

Operation. Firſt draw a Meridian Line, and a Circle round it; place a ſharp Pin upright in the Centre, and the Magnetic Needle thereon, and it will ſhew the Variation required.

Examples for Practice.

151. *Problem* XL. To find a Meridian Line by the riſing and ſetting of the Sun.

Example. I would find a Meridian Line by the riſing and ſetting of the Sun at *London?*

Operation. Obſerve on what Point the Sun riſeth, and alſo on what Point it ſets, the Middle of theſe two is the Meridian required.

Examples for Practice.

152. *Problem* XLI. To find on what Point of the Horizon a terreſtrial Object bears by the Planiſphere.

Example. Suppoſe it was required to find the Bearing of *Greenwich* from *Chelſea?*

Operation. Place the Planiſphere horizontally with its Poles North and Southward by help of a Meridian Line, then by the Degrees or Points of the Compaſs in the Edge of the Planiſphere, will *Greenwich* bear nearly Eaſt from *Chelſea*, which was required.

Examples for Practice.

153. *Problem* XLII. To find all thoſe Places of the Earth where the Sun is either riſing or ſetting, at a given Time.

Example. At what Place of the Earth is the Sun riſing or ſetting, *May* 1ſt, at 10 o'Clock in the Morning, at *London?*

Operation. The Sun's Declination, *May* 1ſt, is 15° $\frac{1}{4}$ North, and at 10 in the Morning, he is 2 Hours ſhort of the Meridian of *London*; therefore count 30° Eaſtward from the Meridian of *London* along the Parallel of 15° $\frac{1}{4}$ North, and you have the Place in *Africa* where the Sun is vertical. Bring the Horizon or Equator of the Slider to paſs through the Place where the Sun is vertical, and count 90° on the ſame, ſo you come to a Meridian paſſing through *New Holland*, *Celebes*, *Minando*, the Sea of *Corea*, and North-eaſt Parts of *Tartary*, which ſhews the Places of Sun-ſetting. Then proceed as in the 34th Problem, and you have a great Circle paſſing between *Paraguay* and *Brazil*, near the Mouth of the River *Amazones*, the *Caribee Iſlands*, *New England*, and *Hudſon's Bay*, the Places where the Sun is ſetting, which was required.

Examples for Practice.

154. ***Problem*** XLIII. To find thoſe Places of the Earth, which are in the enlightened Hemiſphere, at a given Time.

Example. What Places of the Earth are in the enlightened Hemiſphere, *Auguſt* 20th, at 2 in the Afternoon?

Operation. Find all thoſe Places which are within 90° of the Place where the Sun is vertical at the given Time, as in the laſt Problem, and you have the enlightened Part, the Reſt is dark Night or Twilight.

Examples for Practice.

155. ***Problem*** XLIV. To find all thoſe Places of the Earth and Sea, where a ſolar Eclipſe can be ſeen, the Day and Hour when it will happen being given.

Example. To what Parts of the World may the Eclipſe of the Sun be viſible, which will happen *Auguſt* 5th, 1766, at 7 in the Evening?

Operation. Find what Part of the Earth is the enlightened Hemiſphere at the given Time, as in the preceding Problems.

Note, A ſolar Eclipſe is not always viſible throughout the enlightened Hemiſphere, on Account of the Parallax.

Examples for Practice.

156. *Problem* XLV. To find all thoſe Places of the Earth and Sea, where a lunar Eclipſe may be ſeen, the Day and Hour when it will happen being given.

Example. To what Part of the World may the Eclipſe of the Moon be ſeen, which will happen *Auguſt* 20th, 1766, at 7 in the Morning, at *London?*

Operation. Find all thoſe Places which are within 90° Diſtance from the Place where the Moon is vertical at the given Time, ſuppoſing her directly oppoſite to the Sun, for thoſe Places of the dark Hemiſphere within 90° of the Place where the Moon is vertical, are the Places where the lunar Eclipſe is viſible.

Examples for Practice.

157. *Problem* XLVI. To find all thoſe Places which have two Summers and two Winters in one Year.

Example. What are thoſe Places of the Earth's Globe?

Operation. Find thoſe Lands which are under the equinoctial Line, and they are the Places required.

Examples for Practice.

158. *Problem* XLVII. To find the Latitude of a Place of the Earth.

Example. I would find the Latitude of any Place.

Operation. Take the greateſt, and alſo the leaſt Altitude of the Pole-ſtar, or any other Star near the Pole, when he is above, and alſo when he is under the Pole, which Time may be known by his Right Aſcenſion, and the half Sum of theſe two Altitudes,

tudes, (Allowance being made at both Times for Refraction) is the Latitude required.

Examples for Practice.

159. *Problem* XLVIII. To find the Longitude of a Place on the Earth or Sea.

Example. I would find the Longitude of any Place.

Operation. Obſerve the Hour and Minute of either an Eclipſe of the Moon, an Eclipſe of one of *Jupiter*'s Satellites, or Appulſe of the Moon to a fixed Star, at the ſame Inſtant of Time the ſame Phenomenon is obſerved at *London* or any other where, and the Difference of Time converted into Degrees and Minutes, is the Difference of Longitude.

Examples for Practice.

160. *Problem* XLIX. Given the Day of the Month and Latitude of the Place, to find the Hour of Beginning and End of Twilight.

Example. I would know at what Time of the Night the Twilight will end at *London*, *April* 15?

Operation. Turn Z on the Slider to the Latitude 51° ½ on the Planiſphere, and guide your Eye downward along the Parallel of 10° North Declination on the Planiſphere, until you come to 18° of the Meridian Lines of the Slider under its Horizon, ſo you come to a Meridian of the Planiſphere 43° ½ ſhort of Midnight, conſequently the Beginning of Twilight is at 2 Hours 54 Minutes in the Morning, and the End at 9 Hours 6 Minutes in the Evening.

Examples for Practice.

Places. Times. Twilight.

161. *Problem* L. Given the Latitude of a Place, to find what Day of the Year the Twilight is ſhorteſt at that Place.

Example. On what Day of the Year is the Twilight ſhorteſt at *London?*

Operation. Turn Z on the Slider, to the Latitude of 51° ½ on the Side of the Planiſphere, then with a Pair of dividing Compaſſes, or otherwiſe, find out the ſhorteſt Arch of a Parallel of Declination on the Planiſphere, that is contained between the Horizon of the Slider, and the Parallel of 18° under the ſame Horizon, ſo you find the ſaid ſhorteſt Arch of Declination on the Planiſphere to be 20° ½ North of the Equator, which anſwers to *May* 22, and *July* 21, the Days required.

Examples for Practice.

Places. Shorteſt Twilight.

162. *Problem* LI. Given the Day of the Month, Latitude of the Place, and Altitude of the Sun, to find the Hour of the Day.

Example. If the Altitude of the Sun be taken at *London, Auguſt* 11th, and found 11° 15′, what is the Hour of the Day?

Operation. Subtract the Refraction from the given Altitude, and you have 11° 10′ for the true Altitude. Then turn Z on the Slider, to the Latitude 51° ½ on the Planiſphere, and guide your Eye along the Parallel of 15° 7′ North Declination, anſwering to the given Day, until you come to 11° 10′ Altitude on a Meridian of the Planiſphere, which ſhews that the Hour was either 2 Minutes before 6 in the Morning, or 2 Minutes after 6 in the Afternoon.

Examples for Practice.

Places.	Days.	Altitudes.	Hours.

163. *Problem* LII. Given the Latitude of the Place, the Declination and Altitude of the Sun, to find the Azimuth.

Example. If the Altitude of the Sun be taken at *London*, *June* 21, and found 50° after Allowance for Refraction, what is the Azimuth?

Operation. Turn Z on the Slider, to the Latitude of 51° ½ in the Side of the Planiſphere, and guide your Eye downward along the Parallel of 23° ½ North Declination on the Planiſphere, until you come to 50° Altitude above the Horizon, among the Meridians of the Slider, ſo you come to a Meridian on the Slider 59° ¾ from the Side of the ſame, which is the Sun's Azimuth from the South required.

Examples for Practice.

Places.	Days.	Altitudes.	Azimuths.

164. *Problem* LIII. Given the Day of the Month, and the Difference between the Altitude of the Sun taken at one Time of the Day, and the Altitude taken at another Time of the ſame Day; alſo the Difference between the two correſpondent Azimuths taken at the ſame Times the Altitudes were taken, to find the Latitude of the Place.

Example. On the 21ſt of *July*, the Altitude of the Sun was taken in the Forenoon, and his Azimuth taken at the ſame Time; ſome Time after the ſame Afternoon, the Altitude was taken, and alſo his Azimuth at this ſecond Obſervation; and hereby the Difference of Altitudes were found 15° 5′, and the Difference of Azimuths 32° 0′; what was the Latitude of the Place of Obſervation?

Operation. Turn the Slider, until the Parallel of 20° 23′ North on the Planiſphere paſſeth through two Meridians of the Slider, and ſuch Points in them, as at the ſame Time do form the given Difference of Altitudes above the Horizon of the Slider, and the given Difference of Azimuths on the ſame; ſo you have Z on the Slider placed at 55° in the Side of the Planiſphere; the Latitude North which was required.

Examples for Practice.

165. *Problem* LIV. To find the Latitude of a Star given on the Planiſphere.

Example. What is the Latitude of *Syrius* the great Dog?

Operation. Turn Z on the Slider to the Pole of the Ecliptic, ſo the Horizon of the Slider repreſents the Ecliptic, and you have *Syrius* on the Planiſphere, 39° ½ South of the Ecliptic, which is the Latitude required.

Examples for Practice.

Stars.	Latitudes.

166. *Problem* LV. To find the Longitude of a Star given on the Planiſphere.

Example. What is the Longitude of *Capella* in *Auriga*?

Operation. Turn Z on the Slider, to the Pole of the Ecliptic, as in the laſt Problem, and you have *Capella* on the Planiſphere, 78° ½ from the Meridian paſſing through the Centre of the Slider, which is the equinoctial Colure; therefore the Longitude of *Capella* is ♊ 18° ½, which was required.

Examples for Practice.

Stars.	Longitudes.

167. ***Problem*** **LVI.** Given the Latitude and Longitude of a Comet, Planet, or Star, to find its Right Aſcenſion and Declination.

Example. What is the Right Aſcenſion and Declination of a celeſtial Body, whoſe Latitude is 61° 45′ North, and Longitude ♑ 11° 30′?

Operation. Turn Z on the Slider to the Pole of the Ecliptic, on the Weſtern Planiſphere of the Heavens, and counting 11° ½ from the Left-hand Side of the Slider, among the Meridians of the ſame, you come to a Place 61° ¾ North of the ſame Horizon, under which is a Place, whoſe Right Aſcenſion is 267° ½, and Declination 38° ½ North, which was required.

Examples for Practice.

Latitudes.	Longitudes.	Right Aſcen.	Declin.

168. ***Problem*** **LVII.** To find the Diſtance of two Stars that are both on one Planiſphere.

Example. It is required to find the Diſtance of any two Stars that are both on the Eaſtern or Weſtern Planiſphere?

Operation. Turn the Slider round, until a Meridian thereof paſſeth through both the given Stars, and the Number of Degrees, counted on the ſame Meridian, is the Diſtance required.

Examples for Practice.

Stars.	Stars.	Diſtances.

169. *Problem* LVIII. To find the Diſtance of two Stars, one of which is on the Eaſtern, and the other on the Weſtern celeſtial Planiſphere.

Example. It is required to find the Diſtance of any two Stars, one of which is in one Planiſphere, and the other of thoſe Stars in the other Planiſphere?

Operation. Place a black Patch in the ſame Parallel of Declination, and Difference of Right Aſcenſion in one Planiſphere, as is the Declination and Difference of Right Aſcenſion of the other Star in the other Planiſphere; find a Meridian paſſing thro' this Patch and the Star in the ſame Planiſphere, and it is the Diſtance required.

Examples for Practice.

Stars.	Stars.	Diſtances.

170. *Problem.* LIX. Given the Direction of any celeſtial Phenomenon paſſing through any Part of the Heavens in the Arch of a great Circle, to find the Path of the ſame.

Example. Suppoſe a *Comet* was firſt ſeen under the Belly of the *great Bear*, and did bend its Courſe toward *Arcturus* in Bootes; what Conſtellations would it paſs thro', ſuppoſing its Trace to be nearly in the Arch of a great Circle?

Operation. Turn round the Slider, until a Meridian thereof paſſeth through the Places given, ſo will the ſame Meridian paſs through *Mons Menalus*, *Serpentarius*, *&c.* the Places required.

Examples for Practice.

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171. ***Problem*** **LX.** Given a Star on the Planiſphere, to find its Latitude, Longitude, Right Aſcenſion and Declination, for any Year paſt, preſent, or to come.

Example. What Latitude, Longitude, Right Aſcenſion and Declination, will the Pole-ſtar have 1000 Years hence?

Operation. Find how many Degrees and Minutes the Pole-ſtar is got forward in the Ecliptic, allowing at the Rate of 50 Seconds *per Annum*. Then turn Z on the Slider to the Pole of the Ecliptic, and count thoſe Degrees forward under the Star's Parallel of Latitude, ſo you come to a Place on the Planiſphere, which ſhews the Right Aſcenſion and Declination required.

Examples for Practice.

172. ***Problem*** **LXI.** Given the Day of the Month, to find what Hour a Star, Planet, or other celeſtial Body, whoſe Place in the Heavens is known, will come to the Meridian.

Example. At what Time will the *Pleiades*, or Seven-ſtars, come to the South at *London*, *Auguſt* 10th?

Operation. Find the Right Aſcenſion of the Sun for the given Day, and it is 140° $\frac{1}{2}$, count from thence backward, in a Direction contrary to the Order of the Signs, until you come to the Right Aſcenſion of the Seven-ſtars, and you count 53° $\frac{1}{4}$, which ſubtracted from 140° $\frac{1}{2}$, leaves 87° $\frac{1}{4}$, or 5 Hours 49′ after Noon, the Time required.

Examples for Practice.

Stars.	Southing.	Northing.

173. *Problem* LXII. Given the Latitude of the Place, the Month, Day and Hour, to find what Point of the Ecliptic is on the Meridian.

Example. What Point of the Ecliptic is on the Meridian of *London*, *May* 20th, at 9 in the Morning?

Operation. Firſt find the Sun's Right Aſcenſion for the given Day, and count 3 Hours to the Weſtward thereof, ſo you come to 14° ♉, the Point required.

Examples for Practice.

174. *Problem* LXIII. Given the Latitude of the Place, and Hour of the Day, to find the Altitude of *Medium Cæli*.

Example. What is the Altitude of *Medium Cæli*, at *London*, *May* 20th, at 9 in the Morning?

Operation. Firſt find that Point of the Ecliptic which is on the Meridian, and alſo the Place of the Zenith at the given Time, the Diſtance of theſe two ſubtracted from 90°, leaves 44°, the Altitude of *Medium Cæli* required.

Examples for Practice.

175. *Problem* LXIV. To find the oblique Aſcenſion, of any celeſtial Body.

Example. What is the oblique Aſcenſion of the Sun, *May* 20th, for the Latitude of 51° 35′ North?

Operation. Find that Point of the Equator which comes to the Meridian when the Sun or Star riſeth, add 6 Hours thereto, and the Sum is the oblique Aſcenſion required. Hence the Anſwer is 30° 15′.

Examples for Practice.

176. *Problem* LXV. To find the oblique Deſcenſion of any celeſtial Body.

Example. What is the oblique Deſcenſion of the Sun, *May* 20th, for the Latitude of *London*?

Operation. Find that Point of the Equator which comes to the Meridian when the Star ſets, ſubtract 6 Hours therefrom, and the Difference is the oblique Deſcenſion required.

Examples for Practice.

177. *Problem* LXVI. To find the coſmical Riſing and Setting of a given Star.

Example. What Time of the Year doth *Syrius* riſe or ſet coſmically, at *London*?

Operation. Find that Point of the Ecliptic which riſes, when the Star riſes or ſets, and you have the Anſwer *Auguſt* 20, and *February* 24.

Examples for Practice.

178. *Problem* LXVII. To find the anchronical Riſing and Setting of a given Star.

Example. What Time of the Year doth *Syrius* riſe and ſet anchronically at *London?*

Operation. Find that Point of the Ecliptic which ſets at the ſame Time as the Star riſes or ſets, and you have the Anſwer *February* 6th, and *May* 14th.

Examples for Practice.

179. *Problem* LXVIII. Given the three Sides of a ſpherical Triangle, to find the Angles by the Planiſphere.

Example. Given the three Sides of a ſpherical Triangle 38° 28′, 95° and 76°, to find an Angle?

Operation. Bring Z on the Slider to ſo many Degrees from the Pole of the Planiſphere as is one of the given Sides, and count downward from Z toward the Horizon of the Slider, until you have a Point where a vertical Circle of the Slider, and a Meridian of the Planiſphere, anſwer the other two Sides of the Triangle, then one of the Angles is ſhewn on the Horizon of the Slider, another on the Equator of the Planiſphere, and the third Angle may be known by ſhifting the Sides. Hence the required Angle is 60°.

Uſe. By this Problem, having the Latitude, Sun's Altitude and Declination, are found the Azimuth, Angle of Poſition, and Hour of the Day.

Examples for Practice.

180. *Problem* LXIX. Given the three Angles of a ſpherical Triangle, to find the three Sides by the Planiſphere.

Example. Given three Angles of a ſpherical Triangle, 107° 36′, 56° 26′, and 37° 55′, to find an Angle?

Operation. Take the Compliments of the three given Sides to a Semi circle, and proceed with them as if they were Sides finding the Angles for the Sides required. Hence the required Side is 74° 50′.

Uſe. By this Problem, having the Hour of the Day, Azimuth, and Angle of Poſition, are found the Latitude, Sun's Declination and Altitude.

Examples for Practice.

181. *Problem* LXX. Given two Sides of a ſpherical Triangle, and the Angle between them, to find the other Side and two Angles.

Example. Given two Sides of a ſpherical Triangle, 38° 28′, 74° 50′, and the Angle between them 56° 26′, to find the other Side and two Angles.

Operation. Bring Z on the Slider, to ſo many Degrees from the Pole of the Planiſphere, as is one of the given Sides, and count downward from Z, under the given Angle on the Horizon of the Planiſphere, ſo many Degrees as the other given Side; then directing your Eye on that Meridian of the Planiſphere, to its Equator, you have one of the Angles, counting from thence to the Pole of the Planiſphere, you have the required Side; and by ſhifting the Parts, you have the other Angle required. Hence the required Side is 57° 32′, and one of the required Angles 107° 36′.

Uſe. By this Problem, having the Latitude, Azimuth, and Altitude of the Sun, are found the Sun's Declination, Hour of the Day, and Angle of Poſition; alſo, having the Sun's Altitude, Angle of Poſition and Declination, are found the Hour of the Day, Latitude and Azimuth; alſo, having the Sun's Declination, Hour of the Day, and Latitude of the Place, are found, the Azimuth, Altitude and Angle of Poſition.

Examples for Practice.

182. *Problem* LXXI. Given two Angles of a ſpherical Triangle, and the Side between them, to find the two other Sides and Angle.

Example. Given two Angles of a ſpherical Triangle 107° 36′, and 56°26′, and the Side between them 38° 28′, to find the other Angle and Sides?

Operation. Bring Z on the Slider, to ſo many Degrees from the Pole of the Planiſphere as is the given Side, and count downward from the Pole on the Planiſphere, and from Z on the Slider, under the two given Angles, then from the Place where they meet, count upward on a vertical Circle of the Slider, and alſo on a Meridian of the Planiſphere, to the Pole and to Z, and you have the two Sides required; the required Angle may be found by ſhifting the Sides. Hence the required Angle is 37° 55′, and one of the other Sides 57° 32′.

Uſe. By this Problem, having the Hour of the Day, the Latitude of a Place, and Sun's Azimuth, are found the Sun's Altitude, Angle of Poſition, and Declination; alſo, having the Azimuth, Altitude and Angle of Poſition, are found the Declination, Hour of the Day and Latitude; alſo, having the An-

Angle of Poſition, Declination and Hour of the Day, are found the Latitude, Azimuth and Altitude.

Examples for Practice.

183. *Problem* LXXII. Given two Sides of a ſpherical Triangle, and an Angle oppoſite to one of thoſe two Sides, to find the other Side and two Angles.

Example. Given two Sides of a ſpherical Triangle 38° 28′, and 57° 32′, and the Angle oppoſite to the greater Side 56° 26′, to find the other Angle and Sides?

Operation. Bring Z on the Slider, to ſo many Degrees from the Pole of the Planiſphere, as is one of the given Sides, and under the given Angle, count downward from the Pole of the Planiſphere, on a Meridian, until you come to the other given Side on a vertical Circle of the Slider, then the Diſtance on the Meridian from the Pole of the Planiſphere, is the Side required; one of the Angles ſought, is ſhewn on the Horizon of the Slider, and the other Angle required, is found by ſhifting the Sides. Hence one of the required Angles is 107° 36′, and the required Side 74° 50′.

Uſe. By this Problem, having the Latitude of a Place, Hour of the Day, and Sun's Altitude, are found the Sun's Azimuth, Angle of Poſition and Declination; alſo, having the Latitude, Altitude, and Angle of Poſition, are found the Azimuth, Declination, and Hour of the Day; alſo, having the Sun's Altitude, Declination and Azimuth, are found the Latitude, Hour of the Day, and Angle of Poſition; alſo, having the Declination, Altitude and Hour of the Day, are found the Latitude, Azimuth and Angle of Poſition; alſo, having the Latitude, Declination and Angle of Poſition, are found the

Hour of the Day, Azimuth and Altitude; alſo, having the Latitude, Declination and Azimuth, are found the Hour of the Day, Altitude and Angle of Poſition.

Examples for Practice.

184. *Problem* LXXIII. Given two Angles of a ſpherical Triangle, and a Side oppoſite to one of them, to find the other Sides and Angle.

Example. The two Angles given, are 107° 36′, and 56° 26′, and the given Side 57° 32′, required the other Angle and Sides?

Operation. Turn Z on the Slider, until a Meridian on the Planiſphere, with one of the given Angles, cuts off the given Side on a vertical Circle of the Slider, and the ſame vertical Circle ſhews the other given Angle on the Horizon of the Slider; then one of the required Sides is the Diſtance of Z on the Slider from the Pole of the Planiſphere, the other required Side, is the Diſtance of Z from the Pole of the Planiſphere, and the required Angle is found by ſhifting the Sides. Hence the required Angle is 37° 55′, and the required Side 38° 28′.

Uſe. By this Problem, having the Sun's Altitude, Azimuth, and Hour of the Day, are found the Latitude, Declination, and Angle of Poſition; alſo, having the Declination, Azimuth, and Angle of Poſition, are found the Latitude, Altitude, and Hour of the Day; alſo, having the Altitude, Hour of the Day, and Angle of Poſition, are found the Latitude, Azimuth, and Declination; alſo, having the Declination, Hour of the Day, and Azimuth, are found the Latitude, Altitude, and Angle of Poſition; alſo, having the Latitude, Azimuth, and

Angle of Poſition, are found the Altitude, Declination, and Hour of the Day; alſo, having the Latitude, Angle of Poſition, and Hour of the Day, are found the Declination, Altitude and Azimuth.

Examples for Practice.

185. *Problem* LXXIV. To know the Latitude of the Moon, Planets, Comets, or other celeſtial Bodies.

Example. Required the Moon's Latitude at any given Time of the Night when ſhe is viſible?

Operation. Obſerve any two Stars, that are in the Arch of a great Circle with the Moon, Planet, Comet, or other celeſtial Body to be obſerved, which croſſeth the Ecliptic at Right-angles, and note thoſe two Stars on the Planiſphere, then by an Inſtrument (ſuch as *Hadley*'s Quadrant) take the Diſtance from either of thoſe Stars, which added to, or ſubtracted from, the Star's Latitude, gives the Latitude required.

Examples for Practice.

186. *Problem* LXXV. To know the Longitude of the Moon, Planets, Comets, or other celeſtial Bodies.

Example. Required the Longitude of the Moon at any given Time of the Night when ſhe is viſible?

Operation. Obſerve any two Stars, that are in the Arch of a great Circle with the Moon, Planet, Comet, or other celeſtial Body to be obſerved, which croſſeth the Ecliptic at Right-angles, and note thoſe two Stars on the Planiſphere, then turn the Slider until ſome Meridian thereon paſſeth thro' thoſe two Stars on the Planiſpheres, and the Point where it cuts the Ecliptic, is the Longitude required.

Examples for Practice.

187. *Problem* LXXVI. Given the Bearing of the Sun by the magnetic Needle (commonly called the magnetic Azimuth) the Latitude of the Place and Sun's Declination, to find the Variation of the Compaſs.

Example. In Latitude 30° North, *May* 30th, in the Morning, the Sun's Altitude was taken 30°, and his Bearing, by the magnetic Needle, at the ſame Time was due Weſt, required the Variation.

Operation. Find the true azimuth; Place, or ſuppoſe to be placed the true Azimuth over the magnetic Azimuth, and the magnetic North-point falling Eaſtward or Weſtward of the true North-point of the Horizon, ſhews the Variation required.

Examples for Practice.

188. *Problem* LXXVII. Given the Latitude of a Place in the torrid Zone, to find the Sun's greateſt Azimuth on a given Day, when the Sun is nearer the Pole than the Place given; alſo the Altitude of the Sun at the ſame Time.

Example. What is the Sun's greateſt Azimuth, at *Cape Three Points*, on the Coaſt of *Africa*, *June* 20th, and his Altitude at the ſame Time?

Operation. Bring Z on the Slider, to the Latitude given on the Planiſphere, obſerving where the Convexity of the Parallel of Declination on the Planiſphere toucheth an azimuth Circle on the Slider, you have the required Azimuth on the Horizon of the Slider and the Altitude of the Sun at the ſame Time on the azimuth Circle of the Slider, by counting upward from the Horizon.

Examples for Practice.

189. *Problem* LXXVIII. Given the Sun's Declination, Altitude, and greateſt Azimuth, to find the Latitude.

Example. At Sea, in north Latitude, the 20th of *June*, the Sun's Altitude was taken, when he was on the greateſt Azimuth from the North, and found to be 60°, and the greateſt Azimuth at the ſame Time 75°. Quere the Latitude?

Operation. Move the Slider until the given Altitude thereon toucheth the Convexity of the Parallel of Declination on the Planiſphere, and at Z on the Slider, you have the Latitude on the Planiſphere.

Examples for Practice.

190. *Problem* LXXIX. To draw an horizontal Dial for any Latitude by the Planiſphere.

Example. Suppoſe an horizontal Dial was to be drawn for the Latitude of 45° North, what would be the Hour, Half-hour, Quarter-hour, *&c.* Diſtances from the Meridian?

Operation. Turn Z on the Slider to the Latitude on the Planiſphere, and obſerve where 15°, 30°, 45°, *&c.* alſo 7° $\frac{1}{2}$, 22° $\frac{1}{2}$, 37° $\frac{1}{2}$, of the Meridians on the Planiſphere do cut the Horizon of the Slider, ſo you have 10° $\frac{3}{4}$, 22° $\frac{1}{4}$, 35° $\frac{1}{4}$, for the Hour-diſtances, *&c.* required.

Note, The Gnomen, or Style of the Dial, muſt be placed in a Direction parallel with the Axis of the World.

Examples for Practice.

191. *Problem* LXXX. To draw an upright ſouth or north Dial, by the Planiſphere.

Example. Suppoſe an upright ſouth or north Dial was to be drawn for Latitude 55° North?

Operation. Theſe Dials will become horizontal Dials, the former in Latitude 35° South, the later in Latitude 35° North; therefore find the Hour Diſtances for theſe Places, as in the laſt Problem, and you have the Anſwers.

Examples for Practice.

192. *Problem* LXXXI. To draw a declining or reclining Dial, by the Planiſphere.

Note, A declining Dial, is perpendicular to the Horizon, but faceth about more toward the Eaſt or Weſt than a South or North Dial; and a reclining Dial is neither perpendicular to the Horizon, nor parallel thereto, but faceth the Heavens obliquely.

Example. Suppoſe a Dial was to be drawn on a Plane, declining any Number of Degrees toward the Eaſt or Weſt, and reclining any Number of Degrees from the Zenith?

Operation. Firſt place the Gnomen in the Direction of the Axis of the World, and then draw the Hours by the Shadow of the Sun.

Otherwiſe. Project the Meridians on the Horizon of that Degree of Latitude and Difference of Longitude, anſwering to the Plane's, Declination and Reclination.

Examples for Practice.

193. *Problem* LXXXII. To draw Hour-lines on any Surface whatſoever.

Example. Suppoſe it was required to draw Hour-lines on the Cieling of a Room, or any other uneven Surface?

Operation. Place the Gnomen in the Direction of the Earth's Axis, and mark the Hour-lines where they are projected by the Sun.

Examples for Practice.

194. *Problem* LXXXIII. Having the Latitude of your Habitation, and Meridian-line, to determine the Hour of the Day by the Sun.

Example. Suppoſe I would know the Hour of the Day, having a Meridian-line in any known Place of the Earth?

Operation. Place the Planiſphere North and South, and parallel to the Horizon, hang up a Plumb-line, and take the Azimuth; then bring Z on the Slider to the Latitude on the

Planiſphere, and guiding your Eye from the obſerved Azimuth on the Horizon of the Slider upward, until it cuts the Parallel of the Sun's Declination for that Day on the Planiſphere, guide your Eye from thence to the Equator of the Planiſphere, and you have the Hour required.

Examples for Practice.

195. ***Problem*** LXXXIV. Required the following Anſwers, for the Latitude of 50° North, on *May* 16, *viz.*

	Anſwers.	
Sun's Meridian Altitude	59°	10′
Sun's Amplitude	32	30
Sun's Height at 6 o'Clock	15	10
Sun's Azimuth at 6 o'Clock, North-eaſterly	47	15
Sun's Height being Eaſt and Weſt	26	20
Hour when Eaſt	7h	20′
Aſcenſional Difference	26°	20′
Right Aſcenſion	53	10
Hour of Sun-riſing	4h	15′
Hour of Sun-ſetting	7	45
Length of the Day	15	30
Length of the Night	8	30
Longeſt Day in that Latitude	16	10
Shorteſt Day in that Latitude	7	50
Hour of Day-break	1	59
Duration of Twilight	2	15

196. *Problem* LXXXV. Required the following Anſwers, for the Latitude of 50° North, on *November* 23, *viz.*

	Anſwers.	
Sun's Meridian Altitude	19°	30′
Sun's Amplitude South-eaſterly	33	25
Sun's Depreſſion at 6 o'Clock	15	4
Sun's Azimuth at 6 o'Clock, South-eaſterly	77	0
Sun's Depreſſion Eaſt and Weſt	27	30
Hour when Eaſt	4h	42′
Right Aſcenſion	237	35
Hour of Sun-riſing	7	50
Hour of Sun-ſetting	4h	10
Length of the Day	8	20
Length of the Night	15	40
Shorteſt Day in that Latitude	7	46
Longeſt Night in that Latitude	16	14
Hour of Day-break	5	48
Duration of Twilight	2	18

197. *Problem* LXXXVI. Required the following Anſwers, for the Latitude of 35° South, on *November* 10, *viz.*

	Anſwers.	
Sun's Meridian Altitude	72°	10′
Hour of Sun-riſing	5h	9′
Hour of Sun-ſetting	6	51
Sun's Aſcenſional Difference	0	51
Length of the Day	13	42
Length of the Night	10	18
Sun's Right Aſcenſion	225°	40
Sun's Amplitude	80	55
Sun's Height at 6 o'Clock	9	50
Sun's Azimuth at 6 o'Clock, South-eaſterly	70°	0′
Sun's Height when Eaſt and Weſt	30	0
Hour of Day-break	3h	36′
Hour of Twilight ending	8	24
Duration of Twilight	1	33
Hour when Sun is Eaſt	7	44
Hour when Sun is Weſt	4	16
Length of the longeſt Day	14	26
Length of the ſhorteſt Night	18	20

198. *Problem* LXXXVII. Required the following Anſwers, for the Latitude of 45° South, on *July* 29, *viz.*

	Anſwers.	
Sun's Meridian Altitude	26°	26'
Sun's Depreſſion at 6 o'Clock	14	15
Sun's Azimuth at 6 o'Clock, North-eaſterly	75	50
Sun's Depreſſion Eaſt and Weſt	28	30
Sun's Amplitude North-eaſterly	61	50
Sun's Right Aſcenſion	129	
Sun's Aſcenſional Difference	1h	24'
Hour of Sun-riſing	7	24
Hour of Sun-ſetting	4	16
Length of the Day	14	48
Length of the Night	9	12
Hour of Day-break	6	24
Duration of Twilight	1	48
Hour when Sun is Eaſt	4	32
Hour when Sun is Weſt	7	28
Length of the ſhorteſt Day	8	34
Length of the longeſt Day	15	25

199. *Problem* LXXXVIII. To find if it be Leap-year, or how many Years after.

Example. How many Years is it after Leap-year, *Anno* 1770?

Operation. Divide the Year by 4, and if 0 remain, it is Leap-year, but if 1, 2, 3 remains, it is ſo many Years after Leap-year.

Note, The Years 1800, 1900, 2100, 2200, 2300, 2500, *&c.* are common Years.

Examples for Practice.

200. *Problem* LXXXIX. To find the *Sunday* Letter for a given Year, from 1800 to 1899 incluſive.

Example. What is the *Sunday* Letter for the Year of our Lord 1804?

Operation. To the Year of Lord add its Fourth, and divide the Sum by 7, and for the Remainder, if it be 0, count A; if 1 count G; if 2 count F; if 3 count E; if 4, D; if 5, C; if 6, B; for the *Sunday* Letter required.

Examples for Practice.

201. *Problem* XC. To find the Golden-number for a given Year of our Lord.

Example. What is the Golden-number for the Year of our Lord 1770?

Operation. Add 1 to the Year of our Lord, and divide the Sum by 19, the Remainder is the Golden-number.

Examples for Practice.

202. *Problem* XCI. To find the Cycle of the Sun for a given Year.

Example. What is the Cycle of the Sun for the Year of our Lord 1770?

Operation. Add 9 to the Year of our Lord, and divide the Sum by 28, the Remainder is the Cycle of the Sun required.

Examples for Practice.

203. *Problem* XCII. To find the *Roman* Indiction.

Example. What is the *Roman* Indiction for the Year of our Lord 1770?

Operation. To the Year of our Lord add 3, and divide the Sum by 15, the Remainder is the *Roman* Indiction required.

Examples for Practice.

204. *Problem* XCIII. To find the Epact, New-ſtyle, for a given Year.

Example. What is the Epact for the Year of our Lord 1770?

Operation. Multiply the Golden-number by 11, and divide the Product by 30, the Remainder is the Epact, Old-ſtyle. Then from the Epact, Old-ſtyle (augmented by 30, if Need require) ſubtract the Days of Difference between the Old and New-ſtyle, and you have the Epact, New-ſtyle.

Examples for Practice.

205. *Problem* XCIV. To find the Age of the Moon?

Example. What is the Age of the Moon, *January* 1, 1770?

Operation. Add to the Epact for *March* 1, for *April* 2, for *May* 3, for *June* 4, *&c.* and alſo add the Day of the Month; the Sum of theſe three Numbers, or their Overplus above 30, or Thirties, is the Moon's Age required.

Examples for Practice.

206. *Problem* XCV. To find the Time of the Moon's ſouthing.

Example. What Time will the Moon be South, *January* 1, 1770?

Operation. Multiply the Age of the Moon by 4, and divide the Product by 5; the Quotient is the Hour of the Moon's ſouthing required.

Examples for Practice.

207. *Problem* XCVI. To find the Time of High-water at a given Place.

Example. What Time will it be High-water at *London-bridge*, *January* 1, 1770?

Operation. Find how many Hours the Moon is paſt the Meridian, when it is High-water by the Tide-table, add theſe to the Hour of her Southing, and you have the Hour of High-water required.

Examples for Practice.

208. *Problem* XCVII. To find *Eaſter*-day.

Example. What Month and Day will *Eaſter*-day be on, *Anno* 1780?

Operation. Find how many Days old the Moon is, *March* 20, in the given Year, if it be Leap-year, otherwiſe the 21ſt; and if the Moon is 14 Days old on the ſaid 20th or 21ſt of *March*, find what Day of the Week ſhe is ſo old, and the *Sunday* following is *Eaſter*-day. But if ſhe is not 14 Days old on the ſaid 20th or 21ſt of *March*, then count forward to that Day of the Week when ſhe is 14 Days old, and the *Sunday* following is *Eaſter*-day.

209. *Problem* XCVIII. To conduct a Ship from one given Port to another, along the Arch of a great Circle.

Note, By this Kind of Sailing, a Ship ſails to her deſigned Port the ſhorteſt Way ſhe poſſibly can, which, if the Place ſhe ſails from, and that ſhe ſails to, be both in high Latitudes of the ſame Kind, may be ſhorter than by *Mercator*'s ſailing by a ſixth Part of the whole Voyage, and the Longitude may hereby be more correctly aſcertained. Beſides which, this Tract being out of the uſual Courſe, Merchant Ships may hereby often eſcape their Enemy. The principal Objections to this Kind of ſailing, have been, that the Winds will not always permit it to be practiſed, and that it requires a tedious Calculation of ſpherical Triangles, the former of which can have no Weight in the Trade-winds, and the latter may be eaſily removed by the Planiſphere.

Example. Required the Latitudes, and Differences of Longitude by which a Ship muſt paſs, in ſailing from Latitude 32° 30′ North, to Latitude 50° 0′ North, the Difference of Longitude 70° 0′, to keep on the Arch of a great Circle, by the Planiſphere.

Operation. Find two Places on the Planiſphere, whoſe Latitudes and Difference of Longitude agree with thoſe of the given Ports, turn the Slider until ſome Meridian thereof paſſeth through thoſe two Places, and you have the Degrees of Latitude and Difference of Longitude on the Planiſphere, by which the great Circle paſſeth, of which make a Table for every 1, 2, 3, 4, 5, 10, &c. Degrees of Latitude and Longitude. Then for the Courſe at any Place in the Voyage; turn Z on the Slider, to the Latitude of one of the Ports on the Planiſphere, and counting downward from the Pole of the Planiſphere, under the Angle of their Difference of Longitude, to the Latitude of the other given Port, on a Meridian of the Planiſphere, you have the *Courſe* on the Horizon of the Slider. Hence the Anſwers for the Latitudes and Difference of Longitudes by which the Arch paſſeth, are as follows, *viz.*

Diff. Long.	Lat.		Diff. Long.	Lat.	
5°	35°	50′	40°	49°	5′
10	38	50	45	49	50
15	41	25	50	50	15
20	43	35	55	50	30
25	45	25	60	50	35
30	46	55	65	50	25
35	48	5	70	50	0

210. *Problem* XCIX. Given the Latitude and Longitude of a Place at Sea, where the Variation Lines are nearly North and South, to find the Variation of the magnetic Needle at that Place for a given Year.

Note, 1ſt. The Variation of the magnetic Needle, is the Declination of its North Point, either Eaſtward or Weſtward from the true North Point of the Horizon, when the Needle is touched by the Loadſtone, or artificial Magnet, balanced, and freely ſuſpended Parallel to the Horizon.

2d. This Variation is continually increaſing or decreaſing, at all Places on the Surface of the Earth and Sea, by a Law not yet fully diſcovered, whereby it is found greater at one Place than at another, and greater in one Year than another Year at the ſame Place, and ſometimes half a Degree greater at one Time of the Day than another Time of the ſame Day, at the ſame Place.

Example. Suppoſe it be required to know the Variation of the Needle at *Cape Good Hope* for the Year 1765?

Operation. Obſerve how many Degrees of Longitude the Line of Variation hath moved Eaſtward or Weſtward in the given Number of Years for which it is marked; and ſay, by the Rule of Proportion, as the given Interval of Years, is to the given Difference of Longitude, to where the ſame Variation Line is removed; ſo is the Time elapſed from one of the Years for which the Variation Lines were delineated, to the Difference of Longitude, which the ſame Variation Line hath made in that Time, either increaſing or decreaſing, as the Caſe ſhall happen.

Examples for Practice.

211. *Problem* C. Given the Latitude and Variation, to find the Longitude where the Variation Lines run nearly North and South.

Example. Suppoſe a Ship at Sea, near the Iſland of St. *Helena*, in a given Latitude, and Place of a given Variation; how may the Longitude be known?

Find the yearly Motion of the Variation as in the laſt Problem, and thereby the Place of the obſerved Variation in the given Parallel of Latitude, ſo you have the Longitude required.

Examples for Practice.

212. *Problem* CI. Given the Variation of the Compaſs, at two Places, whoſe Difference of Latitude and Difference of Longitude are given, to find the Latitude and Longitude of each of thoſe Places.

Example. Suppoſe the Difference of Latitude between the two Places to be 38°, and their Difference of Longitude 40°, the Variation at the former Place 10° Weſt, and at the latter 20° Weſt; required the Latitude and Longitude of each Place?

Operation. Count among the Meridians and Parallels of Latitude, until you find two Places on the Planiſphere, whoſe Difference of Latitude and Longitude anſwer to thoſe given, and you have the Places required.

Examples for Practice.

I ſhall here propoſe the following Hint, to ſuch Perſons as are aſtronomically inclined, and are deſirous of promoting an Improvement by the Angle of the Sun's Poſition to the Pole and Zenith; which although the Practice of taking the ſame, may have been hitherto neglected, as a Thing either inconſiderable or impoſſible; yet that it is not ſo, will appear on a due Conſideration of the following Particulars.

Definition. In a vertical ſpherical Triangle, the Angle of the Sun's Poſition to the Pole and Zenith, is the Diſtance of the Extremities of two quadrantal Arches, in the Arch of a great Circle, one paſſing through the Sun and Pole, the other paſſing through the Sun and Zenith. And ſeeing that the ſix Parts of a vertical ſpherical Triangle, do depend upon the Sun's Declination, Hour of the Day, Latitude of the Place, Sun's Azimuth, Altitude and Angle of Poſition, the Want of a practical Method for taking the latter, hath hitherto rendered this moſt uſeful Part of Aſtronomy incompleat. Wherefore,

Conſtruction. Let there be formed an Inſtrument, having a Gnomen, horizontal Plane, a Pole and Zenith, with two Arches meeting, and the Point where they meet ſo conſtructed, as to be readily directed to the Sun; the Arch of a great Circle extending from the Ends of the two former Arches, at the Diſtance of 90° from the angular Point.

Uſe. By a Plumb-line, the Latitude of the Place, Hour of the Day, or any other Data, place the whole Inſtrument in the Poſition of the Earth's Globe, direct the Meeting of the two Arches to the Sun, and turn them up to the Pole and Zenith; their Diſtance in the great Circle, from one to the other, is the Angle of Poſition required.

The AUTHOR, on the Receipt of proper Orders, *Poſt-paid*, will cauſe this Inſtrument to be made for Land or Sea; the Uſe of which will be no leſs than from a ſingle Obſervation of the Sun, to determine the Latitude, the Azimuth and Hour of the Day; and in Compoſition with other Data, will be inſtrumental for reſolving many other important Problems.

PARADOXES.

213. THERE is on the *Terraqueous Globe* a certain Parallel of Latitude, to which a Ship may be ſuppoſed to ſail, and to have Sea-room, to depart from that Parallel; but ſuch is the Situation of every Point of that Parallel of Latitude, that no Ship can ſail from the ſaid Latitude, but upon one particular Point of the Compaſs; and the Wind, though it veer round all the 32 Points, will always blow againſt that Point upon which the Ship muſt ſail from that Latitude, and the Wind, though blowing againſt that Point upon which the Ship muſt ſail, yet the Ship may go directly before the Wind.

214. There are two *Places* on the *Terraqueous Globe* ſo ſituated, with reſpect to one another, that from each of thoſe *Places* a Ship may ſail, and though they have Sea-room to all the 32 Points, yet it is impoſſible for them to ſail from thoſe Places but upon oppoſite Points of the *Compaſs*; and though they ſail upon oppoſite Points, yet they may, upon thoſe Points, be either following or meeting one another.

215. There is a certain Place of the *Terraqueous Globe*, to which the *Sun* and *Moon* riſe always in the *South*, and ſet in the *South*.

216. There are two Places of the *Earth* which bear directly *North* and *South* of one another, and their Diſtance from each is 100 Miles, but the true *Courſe* from one of thoſe Places to the other, is to ſail 50 Miles due North, and 50 Miles due South.

217. There is a certain Place on the *Terraqueous Globe*, to which a Ship may ſail directly upon one Point of the *Compaſs*; but there are other fourteen Points on which a Ship may ſail towards that Place, but if ſhe continue to ſail upon e'er a one of the Fourteen, ſhe will always approach to the aforeſaid Place, but will never be able to come to it.

218. There is a certain Parallel of Latitude upon which a Ship may ſail round the Globe, and may all that Time obſerve the Body of the Sun, without his being above the Horizon.

219. There is a certain Place of the *Earth* from which two Ships may depart on one and the ſame Day, yea, and on the ſame Hour and Minute of that Day, and upon one and the ſame Point of the Compaſs, may continue to ſail with the ſame Velocity for the Space of 24 Hours, and though they depart from the ſame Place, and at the ſame Time, and both ſail upon the ſame Point of the *Compaſs*, with the ſame Velocity, yet, in 24 Hours, they will be diſtant from one another above 1000 *Italian* Miles.

220. There is a certain Parallel of Latitude upon which a Ship may ſail at the Rate of 12 *Italian* Miles an Hour, and in 24 Hours her Velocity, meaſured in Degrees of the Equator, ſhall be equal to the Velocity of the *Sun* on the 10th of *June*.

221. There is a certain Place of the *Earth*, from which a Stone of about 10,000 Weight could not fall, though a Pit were digged all round it, and that which is the Cauſe of other Bodies falling from other Places, would be the only Pillar to ſupport a Body in that Place.

222. There are two Parallels of Latitude, in one of which leſs Gold will make a Pound Weight than in the other.

223. There are two Places of the *Earth* where one and the ſame Veſſel will hold more Wine or Water in the one Place than the other.

224. There is a certain Parallel of Latitude from which two Ships may ſail at one and the ſame Moment of Time, with reſpect of real Time, and with reſpect of apparent Time, will differ one intire natural Day; but there is another Parallel of Latitude, to which, if thoſe two Ships ſail upon one and the ſame Point of the *Compaſs*, with the ſame Velocity, they ſhall arrive at that certain Parallel of Latitude at one and the ſame Moment, both with reſpect to real and apparent Time.

225. There is a certain Place of the *Earth* where all the fixed Stars have ſtill the ſame Altitude; and notwithſtanding of the diurnal Revolution of the *Earth*, they always bear upon the ſame Point of the *Compaſs*.

226. There are ſeveral Places at a conſiderable Diſtance from one another, that lie all directly Eaſt of *London*, but *London* does not lie directly Weſt from any of the ſaid Places.

227. The *Chriſtians* obſerve the firſt Day of the Week for their *Sunday*, the *Jews* the Seventh for their *Sabbath*, and the *Turks* the ſixth Day of the Week for the Time of their Worſhip; but there is a particular Place of the Globe, to which, if a *Chriſtian*, *Jew*, and *Turk* ſail in one and the ſame Ship, they ſhall keep the Time for their Worſhip on different Days, as above, all the Time they are ſailing to that particular Place; but when they arrive at that Place, and during the Time they remain at it, they ſhall all keep their *Sabbath* on one and the ſame Day; but when they depart from that Place, they ſhall all differ as before.

228. There is a certain Port, from which, if three Ships depart at one and the ſame Time, and ſail on three particular different Courſes till they return to the Port they departed from, and if in one of theſe Ships be *Chriſtians*, in the ſecond *Jews*, and in the third *Turks*, when they return to the Port they departed from, they ſhall differ ſo with reſpect to real and apparent Time, that they all ſhall keep their *Sabbath* on one and the ſame Day of the Week, and yet each of them, ſeparately, ſhall believe that he keeps his *Sabbath* on the Day of the Week his Religion requires.

229. There is a certain Country in the North-temperate *Zone*, to whoſe Inhabitants the Bodies of the three ſuperior Planets, *Saturn*, *Jupiter* and *Mars* appear to be moſt enlightened, when they are actually leaſt enlightened.

230. There is a Continent all lying in the North-ſide of the Equator, to whoſe Inhabitants the Body of the *Sun* ſeems to be neareſt to them, when he is the fartheſt removed from them.

231. There is a certain Parallel of Latitude, on which Parallel the Star, called the *North Polar-ſtar*, appears by Obſervation, to be 47 Degrees elevated above the *Horizon*, and at another Time the ſaid *Polar-ſtar* will appear, by Obſervation on the ſame Parallel of Latitude, to be at the *Horizon*.

232. There are two Places lying in the *Torrid-Zone*, that are not above 60 Miles diſtant from one another, but if a Ship ſail from one to the other, on one particular Point of the *Compaſs*, the Difference of Time between thoſe two Places, will actually be found to be above 23 Hours.

233. There are 24 Places on the *terraqueous Globe*, in which all the 24 Hours of the natural Day do always exiſt at the ſame Time, and yet the Diſtance of any two of thoſe Places does not exceed 60 Miles.

* * *

CONCLUSION.

FROM the aforegoing Problems, and their Solutions, we preſume it ſufficiently appears, that our Univerſal Planiſpheres, are compleat Subſtitutes for a large Pair of Globes, and that the capital Problems of Geography, Aſtronomy and Navigation, may be ſolved by them. That the Diſtances and Poſitions of Places on the Earth and Sea may be meaſured, and the Place of the Zenith in the Heavens, with the Diſtances and Poſitions of Stars, as accurately aſcertained, as by the Globes themſelves, with their Horizon and Quadrant of Altitude appending. Which, although ſomewhat paradoxical, ſeeing that the Globe hath Dimenſions of Length, Breadth and Depth, and a Rotation round its Axis; whereas our Planiſpheres have no ſuch Properties, but are fixed to the Plane of the Meridian and ſolſticial Colure, with their *Slider* moving in a direct Oppoſition to ſuch a Motion, coincident with the Plane of the Meridian and ſolſticial Colure from the Zenith to the Nadir, or from Pole to Pole; yet their Operations are undoubtedly true, and may be expected to become familiar and eaſy in Practice, to ſuch as ſhall have attentively conſidered their Conſtruction and the aforegoing Examples with the Precepts.

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